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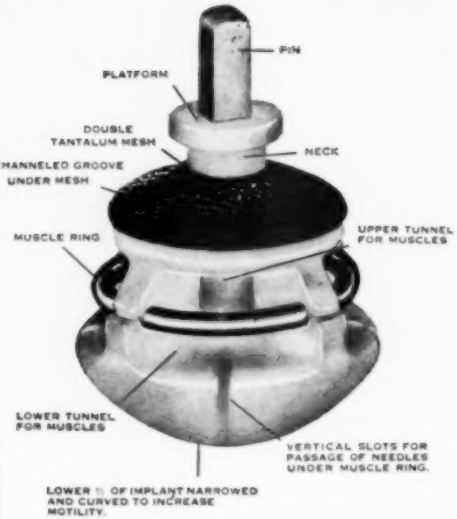

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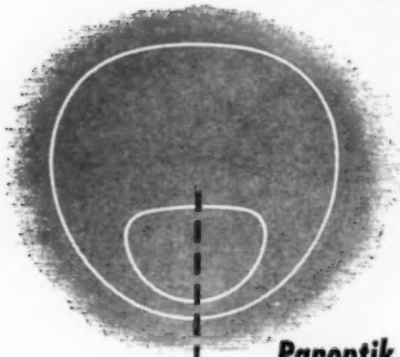

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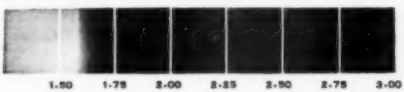

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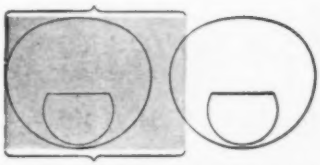

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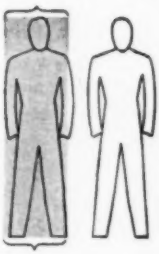

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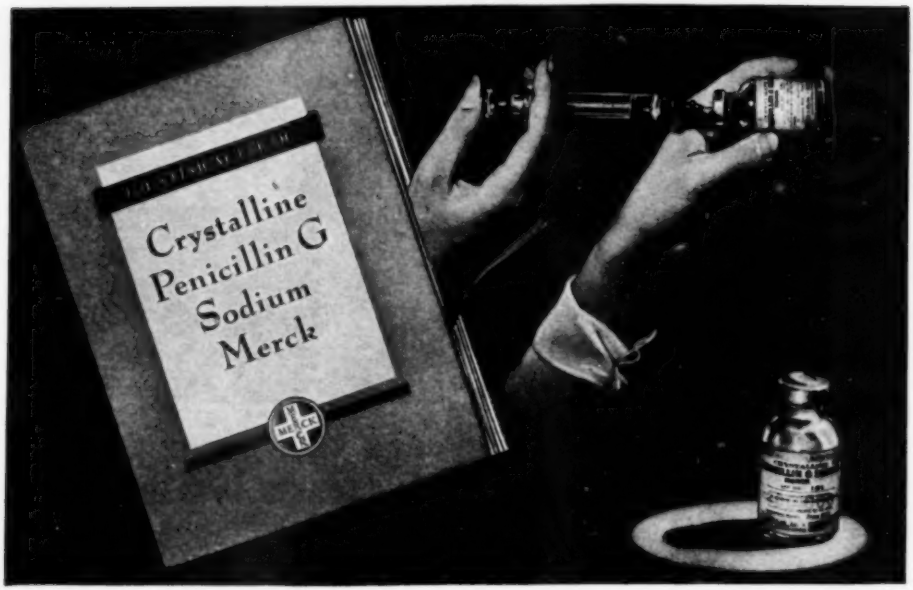

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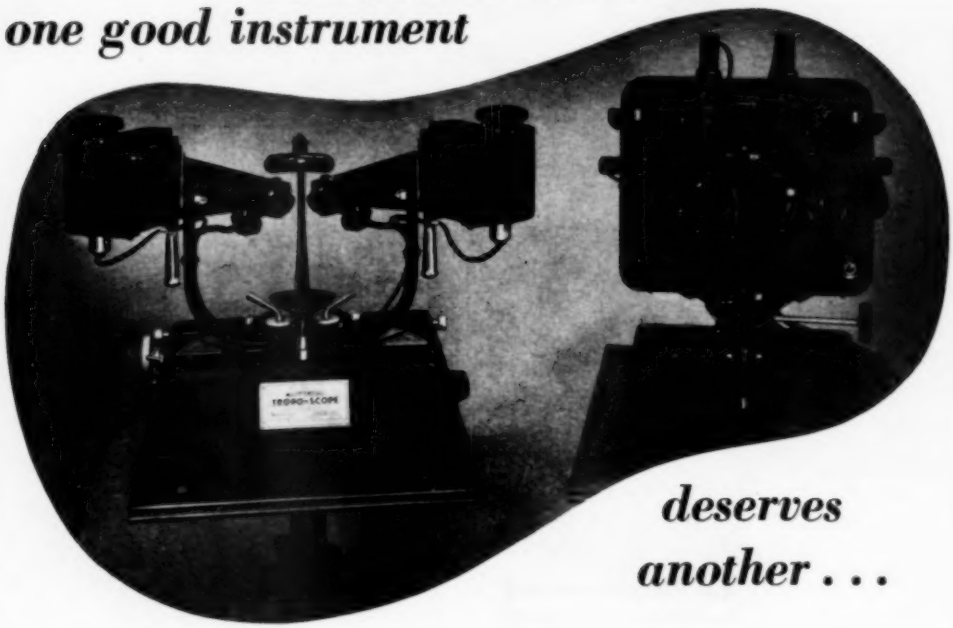

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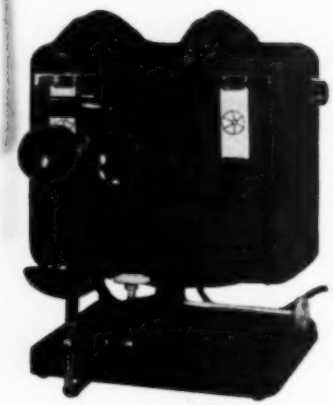

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As pointed out earlier, it is necessary for a lens to be at least 2.8 mm. thick at its thinnest point. This minimum thickness gives the necessary volume to incorporate the stresses. So it becomes evident that case hardened lenses will be much too heavy for high minus or plus corrections. If these high plus or minus cases must have a safety lens it is better to prescribe a laminated glass. For most corrections, however, the case hardened lens works very well and in the case of the active child is almost a necessity.

"IF IT'S A LENS PROBLEM, LET'S LOOK AT IT TOGETHER"

AMERICAN JOURNAL OF OPHTHALMOLOGY

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Retina and vitreous; Optic nerve and chiasm; Neuro-ophthalmology; Eyeball, orbit, sinuses; Eyelids, lacrimal apparatus; Tumors; Injuries; Systemic disease and parasites; Congenital deformities, heredity; Hygiene, sociology, education, and history 602

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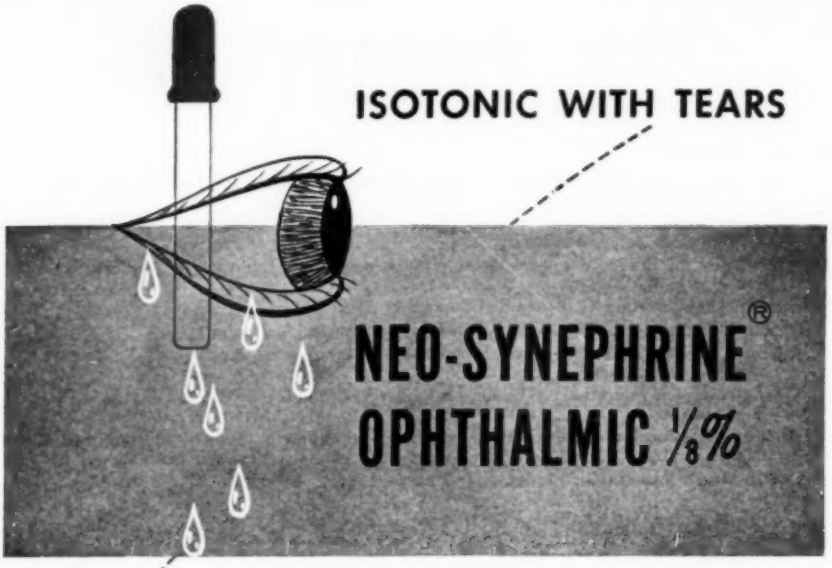

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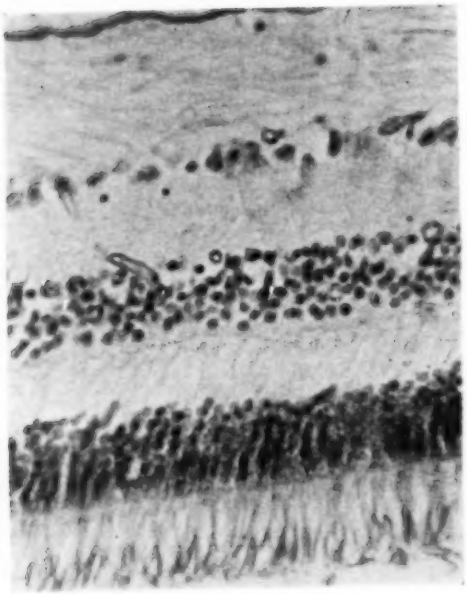

FIG. 1 (FRIEDENWALD). SECTION OF RETINA STAINED WITH HOTCHKISS STAIN AND HEMATOXYLIN.

AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 32 APRIL, 1949 NUMBER 4

A NEW APPROACH TO SOME PROBLEMS OF RETINAL VASCULAR DISEASE*

THE JACKSON MEMORIAL LECTURE

JONAS S. FRIEDENWALD, M.D.
Baltimore, Maryland

I am deeply grateful for the honor and privilege of delivering the Jackson Memorial Lecture. The memory of Dr. Jackson's commanding personality is an inspiration to all of us. His teachings and the JOURNAL which he founded and edited are still a most potent force in American ophthalmology. Within the domain of our science the problems of refraction engaged his deepest interest. Next to these, in his heart, came those of medical ophthalmology. The subject that I have chosen to present is, therefore, one in which I believe he would have been interested.

The problems of retinal vascular disease can be approached from one or the other of two very different viewpoints. One can ask oneself what are the systemic lesions and symptoms that are correlated with a given ophthalmoscopic picture, or one can ask oneself what precisely are the changes in the retinal blood vessels that are responsible for this or that ophthalmoscopic finding.

It is to the second of these questions that I wish to invite your consideration. In the past our studies in this field have been handicapped by considerable technical difficulties. We see a particular type of exudate or hemorrhage in the retina, either ophthalmoscopically or histologically, but the precise point in the vascular tree from which the exudation or hemorrhage arose usually escapes us. Even when we reconstruct in serial sections the neighborhood of a lesion, we can only rarely be sure of the interrelations of our findings.

It has seemed to me, for a long time that, if we could visualize the blood-vessel walls in preparations of the whole unsectioned retina, some interesting patterns of relationships might emerge into view. By great good fortune a suitable technique has become available for this purpose, and I wish to devote this lecture to showing you some of the first fruits of its application.

The development of this technique was in some respects a happy accident, and I should like to tell you the story of how it came about in the hope that you may catch some of the excitement that we experienced, for we started this study as a routine systematic survey, not primarily directed toward retinal vascular disease.

During the last 20 years there has been a steady unfolding of techniques in the field of histochemistry; that is, the techniques by which specific chemical components of the cells and tissues can be recognized in histologic sections. This field has been expanding at an accelerated pace in the last few years, and has been given a more or less definitive pattern by the systematic studies of Wislocki[3] and his colleagues at Harvard.

They have applied one technique after an-

* From the Wilmer Ophthalmological Institute of The Johns Hopkins University and Hospital. Presented at the 53rd annual session of the American Academy of Ophthalmology and Otolaryngology, October 10 to 15, 1948, Chicago, Illinois.

other to one tissue after another and have published comprehensive reports on their findings. Since their studies did not include the ocular tissues, it seemed desirable to follow their footsteps on the material that was readily available in the laboratory for pathology of the Wilmer Institute.

The first technique that we chose to apply was one for the demonstration of fixed carbohydrate that had recently been greatly refined by Hotchkiss[5] and by McManus.[8,9] The technique is simple and easily within the reach of any histologic laboratory. I shall not burden you with the chemical details (see Appendix). With this technique any cellular component that contains carbohydrate is stained red. One can counterstain with hematoxylin so that the general histologic architecture has an approximately familiar pattern, but instead of the usual undifferentiated red of eosin stain only those places in the tissue that contain glycogen, or mucoids, or glucoproteins stain red.

The application of this technique to ocular tissues reveals many points of interest. The mucus in the conjunctival goblet cells and in other mucous glands is brilliantly stained. The elastic membranes of Descemet and Bruch and the lens capsule stain intensely. In the ciliary processes a subepithelial basement membrane is easily demonstrable by this technique, although the presence of such a membrane has been debated by histologists for years. The superficial layer of the ciliary epithelium contains heavy deposits of stainable material, strongly suggesting this as the site of synthesis of the vitreous mucoid. As in other organs, all connective tissue stains faintly but definitely with this technique revealing the presence of mucoid in the ground substance of the connective tissue.

The retina is of particular interest (fig. 1). The internal limiting membrane stains brilliantly showing that this structure is a definite entity and not merely a condensation at the vitreous surface, as has been supposed by some authors. The peripheral portions of the rods and cones contain stainable material which may, perhaps, have an important role in the function of these organs as photoreceptors.

What is particularly striking in the retina is the fact that the endothelium of the whole vascular tree, arteries, capillaries, and veins, is surrounded by a brilliantly stained basement membrane. The presence of this vascular basement membrane can be recognized in some other tissues, but in organs with a connective-tissue stroma it merges into the diffusely staining ground substance of the connective tissue. The existence of a capillary basement membrane in the kidney glomerulus, is, however, well established. Whether such a membrane is demonstrable in all tissues remains still an open question. At any rate the retina is a most favorable tissue for the study of this structure.

The basement membrane is continuous with the internal elastic lamella of the arteries. In arterioles lacking the elastic lamella, the basement membrane is prominently visible and appears to surround individual muscle fibers. In the capillaries it is thinner than in the arterioles but still brilliantly visible. In the venules it is thicker than in the capillaries, but usually less thick than in arterioles of equal size. Since the parenchyma of the retina normally contains no other structures that stain with this technique, it seemed possible that we might with this technique obtain a view of the whole retinal vascular pattern in unsectioned flat preparations of the whole thickness of the retina.

The modifications in the histologic technique required to accomplish this purpose were worked out in our laboratory by Dr. Bernard Becker (see Appendix), and the applications of this technique to various pathologic problems has been pursued in collaboration with Dr. Robert Day. The specimens were prepared with great skill by Miss Sylvia Sigelman and Mrs. Mary Tracey. I am deeply indebted to all of them for their important contribution to this study, and

also to Mr. Delbert Parker for the beautiful photomicrographs which he has made.

The vascular pattern which this technique reveals varies in different portions of the retina. The perifoveal capillary ring (fig. 2) familiar from entoptic studies is well shown. In the region close to the optic disc there are two capillary nets, one in the nerve-fiber layer showing a more or less rectangular or bricklike pattern with the long axis parallel to the direction of the nerve-fiber bundles (fig. 3) and a deeper more irregular net lying mainly in the level of the inner nuclear layer (fig. 4). In the periphery of the retina only the deeper layer persists, and here an avascular zone surrounding the terminal arterioles and venules is often visible (fig. 5).

Fig. 2 (Friedenwald). Flat preparation of normal retina showing the perifoveal capillary net.

In infants up to two years of age the retinal vascular basement membrane is much thinner and less easily seen than in adults (fig. 6). In the fetus one month premature, the basement membrane is visible only in the larger vessels, not at all in the capillaries (fig. 7). It is not possible to say whether the membrane is nonexistent in the fetal capillaries, or merely so thin and delicate as to be invisible. What is of some interest is that the stainability of the mem-

Fig. 3 (Friedenwald). Normal retina. Capillary net in the nerve-fiber layer near the optic disc.

Fig. 4 (Friedenwald). Normal retina. Capillary net in the layer of bipolar cells.

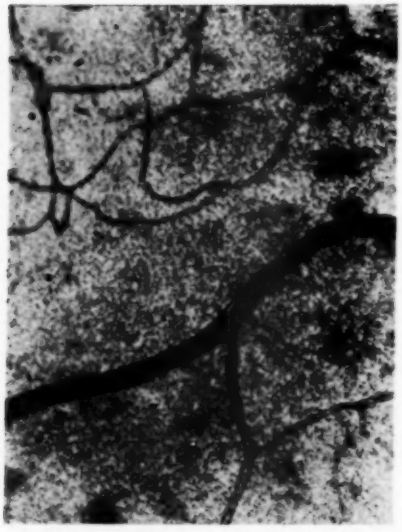

Fig. 5 (Friedenwald). Normal retina. Capillary net in the periphery of the retina.

brane appears to be related to the age of the individual rather than to the age of the capillary, for newly formed capillaries, for instance in retinitis proliferans, show a well-developed basement membrane in the adult.

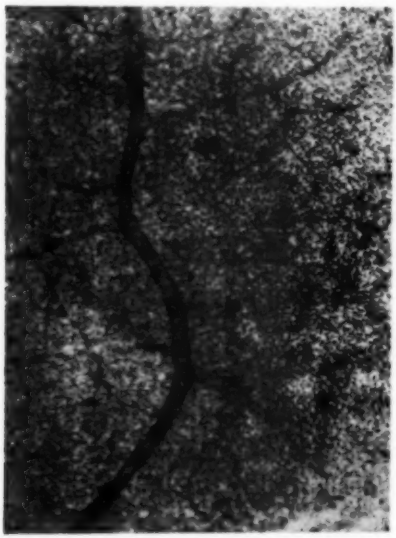

Fig. 6 (Friedenwald). Normal retina from a two-year-old infant. Note the feeble development of the vascular basement membrane.

Diabetic retinopathy

The first pathologic problem that we have attacked with this technique is that of diabetic retinitis. Before showing you the results of this study, I must ask your indulgence to allow me to correct an error which I made in this matter a number of years ago. In a paper which I presented to the scientific session of this society in 1936, I reported a study on diabetic retinitis which revealed that patients suffering from this condition quite regularly showed an increased capillary fragility. This finding has been abundantly confirmed by others.

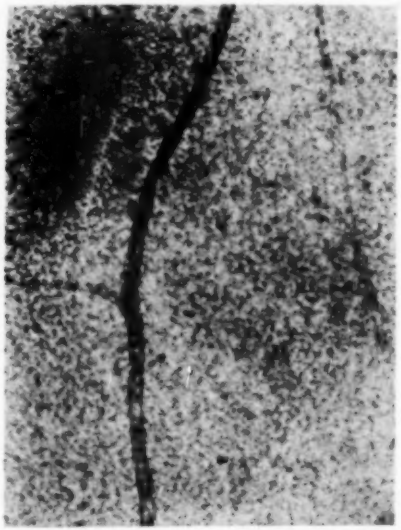

Fig. 7 (Friedenwald). Normal retina from a stillborn infant one month premature. Note that the capillary basement membrane is not visible.

A series of these patients whom I studied all failed to excrete in their urine any considerable quantities of vitamin C even when enormous amounts of this material were ingested. I concluded that these patients had an abnormality in their vitamin-C metabolism, and that this might be related to their

abnormal capillary fragility and to their retinal hemorrhages. This conclusion was mistaken.

As soon as methods were available for the study of the plasma vitamin-C level, it was found that these patients had, for the most part, quite normal plasma levels, and that their failure to excrete the vitamin was merely due to abnormally high renal thresholds. Fortunately the error was detected between the time of the delivery of my paper and the subsequent publication of the *Transactions,* whose editor kindly consented to allow the paper to be suppressed.

The reason why these patients commonly have a high renal threshold for vitamin C, and also for glucose, will become apparent in the further discussion, but there is no evidence that vitamin C is in any direct way concerned in the vascular lesion.

In the study of the retinal lesions which I presented at that time, it was possible to show that some of the small red spots which we observe ophthalmoscopically in these cases are not petechial hemorrhages as they appear to be, but are actually small capillary aneurysms, and can be recognized as such in serial sections. The existence of these capillary aneurysms was subsequently more elegantly demonstrated by Ballantyne and Loewenstein.[2] It has remained unclear, however, whether these aneurysms occur primarily as such without rupture of the capillary wall, or whether they begin as minute petechiae which are subsequently grown over by endothelium. Also the relation of these aneurysms to the exudates and to the frank hemorrhages has remained obscure.

Flat preparations of the retina in cases of diabetic retinitis show great numbers of capillary aneurysms (fig. 8). These aneurysms always have both an afferent and an efferent connection, and are, therefore, true aneurysmal dilatations, not endothelialized petechiae which would be connected to the vascular tree by a single channel. In some capillaries tiny knuckles can be seen in the walls, possibly representing the first stage of

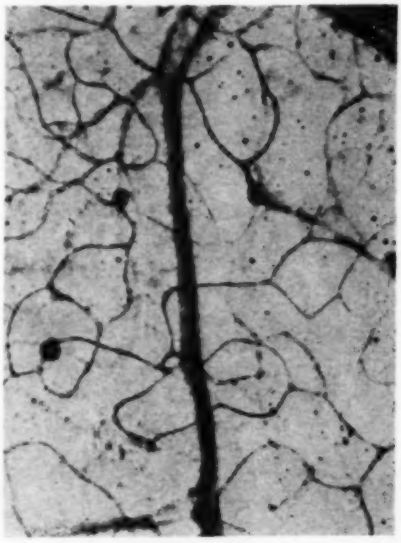

Fig. 8 (Friedenwald). Diabetic retinitis with capillary aneurysms.

aneurysm formation. The aneurysms are most frequent in the central retinal region but occasionally can be found even quite far out in the periphery.

Very commonly there is a cluster of exudates in the retina surrounding the aneurysms (figs. 9 and 10). These exudates usually lie in the outer fibrillar layer while the aneurysms are usually in the inner nuclear layer, but they surround the aneurysms so frequently as to suggest that they are formed by leakage of plasma from the aneurysmal wall. Frequently also there are frank hemorrhages in the tissue adjacent to the aneurysms (fig. 11). I do not wish to imply that hemorrhages and exudates in these cases arise only from the aneurysms, but merely that the majority do arise in this fashion.

Similar capillary aneurysms are occasionally seen in cases of retinal vascular disease in nondiabetics, but they are quite rare and when they occur we have, so far, found not more than 2 or 3 of them in a whole retina. In the diabetic retinopathy the aneurysms

Fig. 9 (Friedenwald). Diabetic retinitis. Cluster of exudates surrounding a capillary aneurysm.

are regularly present by dozens, sometimes by hundreds, and their pattern with the surrounding exudates and hemorrhages appears, so far, to provide a characteristic picture. Up to the present we have concentrated our attention on advanced cases of retinitis in long-standing diabetics. It will be interesting to trace the early stages of this disease process.

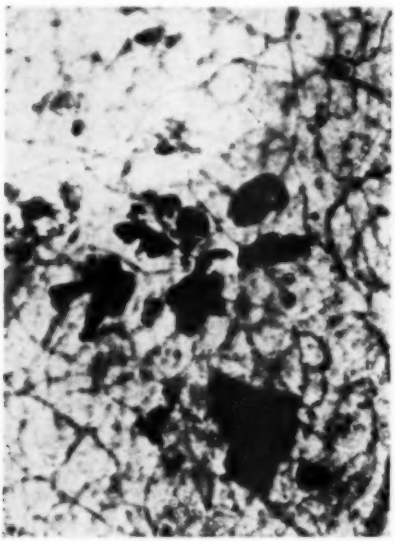

Fig. 10 (Friedenwald). Diabetic retinitis. Cluster of exudates surrounding a capillary aneurysm.

Many of the aneurysms show thickened walls (figs. 12, 13, and 14), intensely stained by the histologic procedure that we have used, and sometimes these thickened walls show concentric lamellae as if successive layers of the material had been laid down. In some, the process seems to have reached complete occlusion of the aneurysmal cavity.

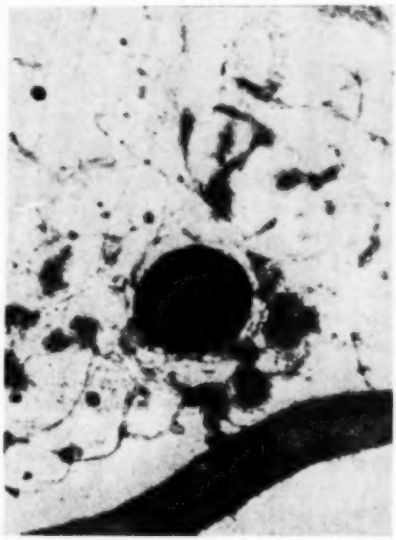

Fig. 11 (Friedenwald). Diabetic retinitis. Hemorrhages and exudates surrounding a capillary aneurysm.

Once recognized, these aneurysms with thickened walls can also be found in ordinary histologic sections in which the material composing the thickened walls has the histologic characteristics of hyalin. At first sight one would mistake these lesions for venules with hyalinized walls, but they are found in the inner nuclear layer where veins of this size are normally absent. If similar lesions should occur in other organs

they would, no doubt, be difficult to identify without serial sections, and careful reconstruction of the vascular pattern.

It is to be remembered, however, that in 1936 Kimmelstiel and Wilson[7] described a form of "intercapillary glomerular sclerosis" which they believed was characteristic of the diabetic nephropathy. In its most outspoken

Fig. 12 (Friedenwald). Diabetic retinitis. Capillary aneurysms with thickened walls.

form the lesion consists of globular masses of hyalin material lying within the glomerular tuft. Often these globular masses show concentric lamellation. In this outspoken form, the lesion occurs almost exclusively in longstanding diabetics and, as Wagener[4] and others have shown, is very commonly associated with diabetic retinitis. In our own material we have found innumerable retinal capillary aneurysms in every case of outspoken Kimmelstiel-Wilson nephropathy that we have so far studied.

When kidney sections showing the Kimmelstiel-Wilson lesion are stained for carbohydrate with the Hotchkiss technique, the characteristic hyalin nodules stain intensely red and strongly suggest the appearance of

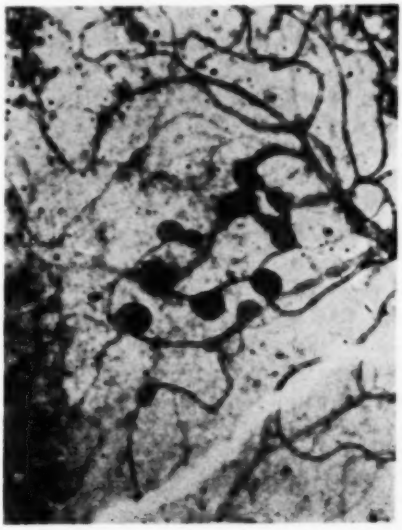

Fig. 13 (Friedenwald). Diabetic retinitis. Capillary aneurysms with thickened walls.

the thickened walls of the retinal capillary aneurysms.

Moreover, Allen,[1] who has given the most detailed histologic analysis of the Kimmel-

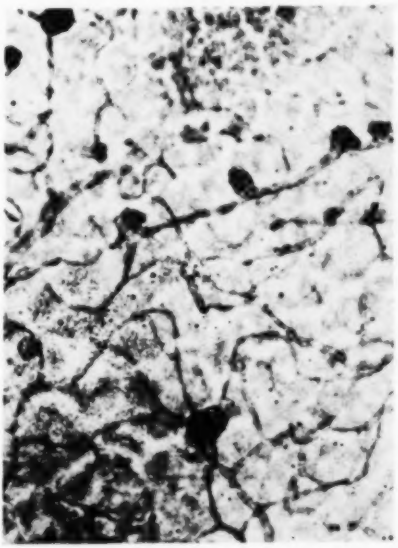

Fig. 14 (Friedenwald). Diabetic retinitis with capillary aneurysms, some with thickened walls.

stiel-Wilson lesion, points out that the characteristic hyalin nodules are often associated with what he described as markedly dilated capillaries packed with red blood cells. One is tempted to suspect that these so-called dilated capillaries are, in fact, capillary aneurysms, and we have undertaken the tedious process of serial reconstruction of these lesions in order to find out whether or not this is in fact true.

Unfortunately we cannot simply stain sections of kidney with the Hotchkiss stain and thus reveal the capillary pattern. In the kidney there are tubular and glomerular basement membranes which stain very intensely and obscure the capillary pattern even in the normal glomerulus.

It would be incorrect for me to leave you with the impression that pathologists are in general agreement over the interpretation of the lesions which Kimmelstiel and Wilson were the first to describe. In the glomerules of cases showing the typical nodular masses of hyalin, one commonly finds in addition irregular hyalin thickenings of the capillary wall and hyalin sheets or bands lying between capillaries. These nonnodular lesions are, however, found also in a great many nondiabetic cases of nephrosclerosis and chronic glomerulonephritis.

Those pathologists whose attention has been focused on the nonnodular lesion have argued strongly that there is nothing about this lesion that is specific of the diabetic, and have tended to belittle the significance of the nodular lesions as presenting merely an accidental configuration of nonspecific significance. The argument, both pro and con, has recently been reviewed by Kimmelstiel and Porter.[6]

If, however, it should be found that the nodular lesions represent occluded capillary aneurysms, then the nodular configuration would bring the renal lesion into close relation with that which is so characteristically found in the retina. If it should be proved that the Kimmelstiel-Wilson lesion in the kidney and the capillary aneurysms in the retina are, in fact, manifestations of the same vascular process, then we shall have to search for similar changes in other organs.

These are, however, questions which only the future can decide. In any case, the evidence we have so far accumulated strongly supports the conclusions of Ballantyne that capillary aneurysms are a characteristic feature of diabetic retinopathy and quite characteristically distinguish this disease from the retinopathy of arteriosclerosis or of malignant hypertension.

Cotton-wool spots

The second pathologic problem to which we have applied this technique is that of the so-called cotton-wool spots so commonly seen in the retinitis of malignant hypertension. These are white spots of fuzzy outline, generally about one fifth the diameter of the optic disc in size. They are seen only in the posterior pole of the retina and plainly lie in the retinal nerve-fiber layer. They are not pathognomonic of malignant hypertension and are found, although less frequently, in a variety of other conditions, for instance in severe anemias and in the terminal stages of carcinomatosis. Attention has recently been called to their occurrence in periarteritis nodosa, lupus erythematosus, and the related acute collagen degeneration diseases.

They are related to the Roth spots of septic retinitis in which the spots commonly have small hemorrhagic centers. The term cotton-wool spots was coined by our British colleagues, who speak of absorbent cotton as cotton-wool, and is well chosen, for these spots indeed have the appearance of tiny cotton pledgets.

On section these lesions have been shown to correspond to areas in which the retinal nerve-fiber layer is swollen and include curious cell-like bodies with a central eosinophile globule. These so-called cytoid bodies were originally thought to be swollen nerve fibers, but studies many years ago revealed that they were globular, not cylindrical, in form and, consequently, that they represent a

peculiar type of cellular degeneration. The origin of these cytoid bodies still remains obscure and I have nothing to add on that score. It seemed possible, however, with this new technique to clarify at least the relation of the total lesion to the vascular net.

The problem was considerably simplified by the fact that the cytoid bodies contain material that stains intensely in our preparations. The location of these lesions in flat

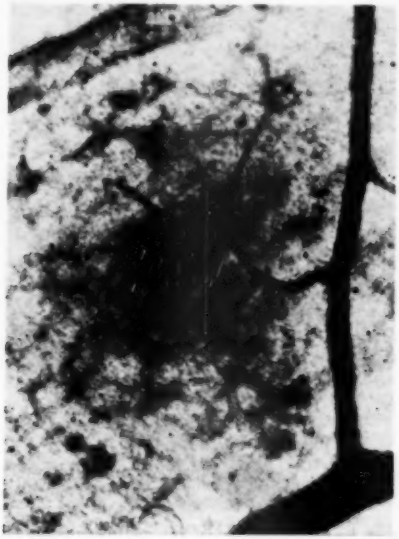

Fig. 15 (Friedenwald). Cytoid body lesion in relation to a terminal arteriole.

preparations of the retina is, consequently, clearly revealed (figs. 15, 16, and 17).

The specimens show that the lesion is regularly located between the terminal bifurcation of a terminal arteriole, and they have precisely the configuration to be expected if the arterial flow were occluded just upstream from this terminal bifurcation. It is plain, then, that these lesions represent minute ischemic infarcts.

Since, in most instances, the arteriole is not actually occluded in the section, these infarcts presumably can result from arteriolar spasm. This conclusion has indeed been

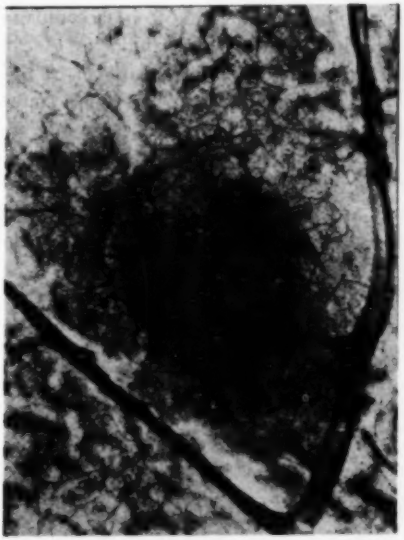

Fig. 16 (Friedenwald). Hypertensive retinitis. Cytoid body lesion in relation to a terminal arteriole.

suspected for many years. The present findings lend it much new weight.

If these lesions are ischemic infarcts, then

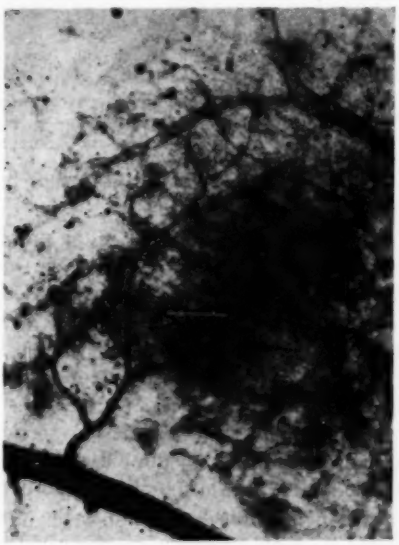

Fig. 17 (Friedenwald). Cytoid body lesion in relation to a terminal arteriole.

one would expect healing to be accompanied by the ingrowth of new capillaries. A careful study of a considerable number of these lesions revealed that many of them contain curiously irregular capillaries with very wide lumens and an irregular angular course differing from the normal pattern (fig. 18). They are seen usually on the venous side of the lesion and are most prominent in those lesions in which the cytoid bodies themselves are relatively feebly stained.

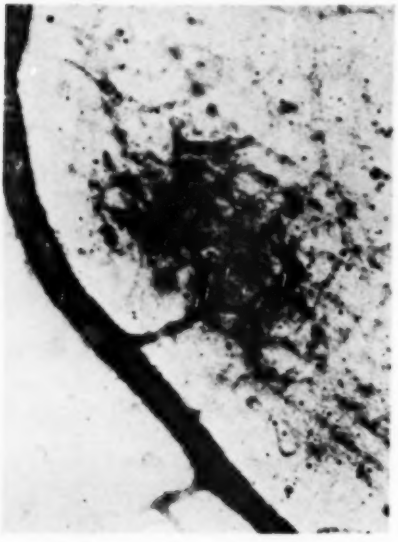

Fig. 18 (Friedenwald). Cytoid body lesion with irregular newly formed capillaries.

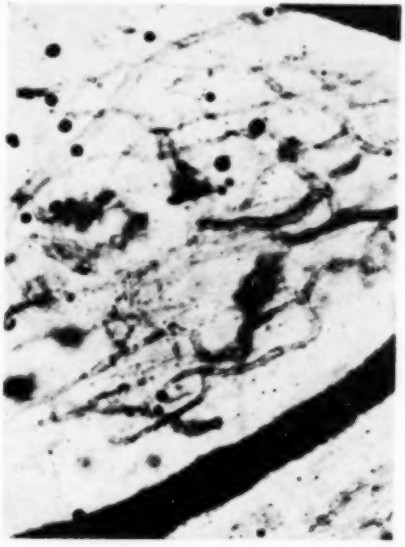

Fig. 19 (Friedenwald). Newly formed capillaries in the region of a presumably healed cytoid body lesion.

It would appear, then, that in the process of healing the cytoid bodies lose their carbohydrate content and disappear while new capillaries grow into the damaged area. Clinical experience indicates that these lesions usually disappear from ophthalmoscopic view in 2 to 4 weeks.

The fact that formed capillaries, presumably not more than a month old, show well-developed basement membranes supports the conclusion mentioned above that the presence of a visible basement membrane has to do with the age of the individual rather than with the age of the capillary.

After complete resorption of the lesion, one would expect the malformed capillaries to persist. In retinas showing numerous active lesions we have sought for and found what we take to be such healed lesions showing a group of angular and dilated capillaries in a zone between the terminal fork of an arteriole with no identifiable remains of cytoid bodies (fig. 19).

The identification of the cotton-wool spots as ischemic infarcts in the nerve-fiber layer raises interesting questions as to why these lesions are limited to this portion of the retina. Are the arterioles which supply the deeper capillary net less susceptible to spasm and occlusion? Does the deeper capillary net have a more abundant system of collateral connections? Are the tissues supplied by this deeper net less susceptible to damage by ischemia, or do they manifest their injury by a different type of response,

It is, I think, usual that the introduction of a new technique into a particular field of study results in raising more new questions than answers. Consequently, I trust that you will forgive me for the many unanswered

questions which this study has brought out. The technique that we have used is an extremely simple one, and I hope that many of you will find it possible to apply it to a great variety of problems.

Appendix

The chemical procedure consists in exposing fixed tissue or tissue sections to the action of periodic acid, which oxidizes the alcoholic group of carbohydrates to aldehydes and ketones. These groups in the tissue are then stained with the fuchsin-sulfite reagent of Feulgen. The specificity of the staining reaction has been discussed by Hotchkiss.[6] The following directions are quoted from Hotchkiss.

Staining procedure according to Hotchkiss

Fixation may be in usual fixatives; mercury salts, if used, are removed with iodine; formaldehyde, if used, is removed by thorough washing. If glycogen, or other easily soluble polysaccharide, is to be demonstrated, fixation and washing should be in alcoholic or other fluids that do not dissolve this substance.

Approximately 70-percent alcohol has successfully been used for washing in such cases, and the standard procedure suggested here calls for this environment up to the stage at which fuchsin-sulfite is used. Whenever such precautions are unnecessary, aqueous solutions may be used.

After bringing the section or smear into alcohol:

a. Leave 5 minutes at room temperature in periodic acid solution A.

b. Flood with 70-percent alcohol, transfer to reducing rinse, leave 5 minutes.

c. Flood with 70-percent alcohol, leave 15 to 45 minutes in fuchsin-sulfite.

d. Wash 2 to 3 times with SO_2-water as for Feulgen staining, dehydrate, and mount as usual.

e. Counterstaining (if desired): If staining is mainly to show polysaccharides, counterstain with a basic dye. Malachite green in dilute aqueous solution (about 2 mg/100 cc.) has been satisfactory for some preparations. This will tend to stain the nucleic acids, which are not affected by the periodatefuchsin. If staining is intended for mucin or acid polysaccharides, it is presumably better to counterstain with an acid dye.

f. Control sections are carried through the same process, eliminating step (a).

Solutions Used

Periodic acid A. Four-hundred mg. periodic acid, dissolved in 10 cc. distilled water, add 5 cc. of *M*/5 sodium acetate (equivalent to 135 mg. of the hydrated crystalline salt) and 35 cc. ethyl alcohol. (The periodic acid, H_5IO_6, was purchased from the G. Frederick Smith Chemical Co., Columbus, Ohio.) This solution may be used for several days if protected from undue exposure to light.

Periodic acid B. Four hundred mg. periodic acid dissolved in 45 cc. distilled water, add 5 cc. of *M*/5 sodium acetate.

Reducing rinse. One g. potassium iodide, 1 g. sodium thiosulfate pentahydrate are dissolved in 20 cc. distilled water. Add, with stirring, 30 cc. ethyl alcohol, and then 0.5 cc. 2 *N* hydrochloric acid. A precipitate of sulfur slowly forms and is allowed to settle out, although the solution may be used immediately. (This is designed to be an iodide-thiosulfate solution containing the maximum amount of mineral acid compatible with the thiosulfate; when it ceases to be acidic, it should be reacidified or replaced.)

Fuchsin-sulfite. This may be as used for the Feulgen stain. The solution prepared as follows is satisfactory. Two g. basic fuchsin are dissolved in 400 cc. boiling water, cooled to 50°C., and filtered. To the filtrate are added 10 cc. 2 *N* hydrochloric acid and 4 g. of potassium metabisulfite. Stopper and leave in the dark in a cool place overnight. Add 1 g. decolorizing charcoal, mix and filter promptly. Add up to 10 cc. or more 2 *N* hydrochloric acid in small portions until, after the last addition, the mixture, spontaneously drying in a thin film upon a glass slide, does not become pink. Preserve in the dark, well stoppered.

Sulfite wash water. Fifty cc. distilled water containing 0.5 cc. concentrated hydrochloric acid and 0.2 g. potassium metabisulfite.

Modifications. As mentioned, aqueous solutions may be used, whenever insoluble polysaccharides only are of interest. Aqueous periodic acid (solution B) is usually somewhat more rapid and vigorous in its action than solution A.

Rinsing is needed to remove entrapped or combined periodate or iodate; either salt gives a reddish coloration with fuchsin-sulfite. While a somewhat longer rinse in 70-percent alcohol (or water) may frequently be adequate to remove these salts, the reducing rinse is more positive in its action. It would probably be dangerous to use acid iodide and thiosulfate in separate solutions, since the liberated iodine might destroy aldehyde groups if not immediately reduced by thiosulfate. Such substances as glucose or ethylene glycol reduce periodate but not iodate.

If control sections reveal that free tissue aldehydes are present before oxidation with periodic acid, treat tissues as directed by Feulgen and Voit, Arch. ges. Physiol. (Pflugers) **206**:389, 1924.

Excessive egg white used in coating slides, if not well drained, contains enough carbohydrate to accept a barely perceptible stain.

Preparations stained and mounted when this work was begun are still apparently unchanged 2.5 years later.

Spot Tests With Periodate-Fuchsin

Solutions containing approximately 1 mg. of various preparations are placed in a spot plate and treated for 5 minutes with one drop of periodic acid. Toward these aqueous solutions, the fresh alcoholic solution A is fully as vigorous as solution B and the drops are of a more convenient size. Because the periodic acid (and acetate buffer) is not removed, an appropriate small excess of dilute hydrochloric acid is added immediately before the

reducing rinse. A periodic acid blank reduced in this way should give no coloration with Schiff's reagent, and also not interfere with color development when a drop of very dilute formaldehyde is added.

Satisfactory proportions are:

a. Water or polysaccharide solution, 0.05 to 0.2 cc.

b. Periodic acid solution A, 0.025 cc. (or 1 drop). Leave 5 minutes.

c. *N*/10 hydrochloric acid, 0.05 cc. (or 1 drop).

d. Reducing rinse (alcoholic), 0.1 cc. (or 4 drops). Mix.

e. Fuchsin-sulfite reagent, 0.05 cc. (or one drop). Leave 15 minutes.

Similar proportions of the aqueous solutions may be used, making allowance for larger drop size.

MODIFICATION OF HOTCHKISS TECHNIQUE FOR STAINING OF UNSECTIONED RETINA

The retina may be dissected out of the eye after fixation or may be recovered from paraffin embedded blocks after routine histologic sections have been cut from the block. In the former case the retina is washed in tap water for 24 hours and then in distilled water and is then ready to be treated with periodic acid. In recovering the retina from paraffin embedded material, the block is melted in a paraffin oven and the tissue transferred to xylol for 4 hours. The retina is dissected out of the eyeball and placed in fresh xylol overnight. It is then placed successively in absolute alcohol, 95-percent alcohol, 80-percent alcohol each for at least 8 hours, and then thoroughly washed in distilled water.

The tissue is placed in Hotchkiss *periodic acid solution* B for 20 minutes, washed in distilled water 30 to 60 seconds, and placed in the *reducing rinse* for 20 minutes. After washing in distilled water for 30 to 60 seconds, it is placed in the *fuchsin-sulfite* (Feulgen reagent) for 1½ hours. It is then washed in three changes of the *sulfite wash* for 10 minutes each, and then in three changes of tap water. The tissue is dehydrated in two changes of 95-percent alcohol for 10 minutes each and then in two changes of absolute alcohol for 10 minutes each, cleared in xylol and mounted in balsam (nerve-fiber layer up).

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USE OF TANTALUM IMPLANTS FOR INDUCING A PERMANENT HYPOTONY IN RABBITS' EYES*

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In a paper published in 1940,† I described some experimental and clinical work on the use of the metal magnesium as an implant after cyclodialysis operations. My purpose was to keep both sides of the wound separated from each other during the whole period of cicatrization, so that a permanent aperture could be achieved between the anterior chamber and the perichoroidal space. The magnesium was used because this metal is completely absorbed by the tissues and at the end of three weeks has entirely disappeared. Unfortunately, magnesium gives a great amount of hydrogen gas, which in some cases could not be evacuated through the incision in the sclera and produced pain in the eye.

Considering the excellent results obtained by brain surgeons who have used plates of tantalum in repairing cranial defects, I thought it would be worthwhile to find out if it could be applied also to the inner membranes of the eye without risk to the integrity of the organ.

I started a series of experiments in rabbits in an endeavor to ascertain: (1) How well the inner structures of the eye could tolerate the presence of tantalum; (2) if this metal could be used to keep the sclerocorneal hole in the limbus open permanently after trephine operations; (3) if it were possible to maintain, with tantalum, a new channel of outflow from the anterior chamber to the perichoroidal space.

Tantalum has been known and used extensively in surgery since 1940. It has a characteristic blue-gray color, is a basic element, and has a density of 16.6 gm. per cubic centimeter. It is malleable and ductile. It remains unchanged in normal tissues; is nontoxic and nonabsorbable. It can be drawn into a wire as fine as human hair or rolled into a thin foil. Its chief value in brain surgery lies in the fact that, because of its chemical properties, it allows the tissue cells to have a normal growth undisturbed by its presence. The tissue shows little or no evidence of foreign-body reaction and a minimum of leukocytic infiltration and gliosis. Some authors have demonstrated that fibroblasts may even grow attached to tantalum implants.

Ophthalmic surgeons now use this metal extensively after enucleation and evisceration of the eye to obtain permanent orbital prosthetic implants. Tantalum can be obtained from Johnson and Johnson's Ethicon Suture Laboratories in three forms: (1) Metallic wire in different thicknesses, either in spools or threaded in atraloc needles for sutures. (2) Tantalum plates or fine tantalum foil. (3) Tubes with a lumen of 1 mm. and thick walls. These can be cut to any required length with strong scissors and filed to make spurs or flanges.

EXPERIMENTAL PROCEDURES

EXPERIMENT 1

My preliminary step consisted in depositing a piece of tantalum wire in the anterior chamber of a rabbit's eye and studying the reaction of the tissues to the foreign body. The tantalum wire was about 2-mm. thick and 4-mm. long and was sterilized in the dry-heat oven. It was introduced into the eye through a scleral incision 2-mm. back from the upper limbus and deposited into the ciliosclera sinus. Its tips appeared in the anterior

* From the Department of Ophthalmology, Columbia University, and the Eye Institute of the Presbyterian Hospital. This work was made possible by a grant from the Harriman Glaucoma Fund.

† Cyclodialysis with insertion of a metal implant in the treatment of glaucoma: A preliminary report. Arch. Ophth., 23:270-300 (Feb.) 1940.

chamber. The conjunctival flap over the wound was sutured as usual.

Two days later the eye showed little reaction, but the cornea was hazy in front of the implant. A small hemorrhage appeared on the iris. One week later the reaction subsided, but the cornea continued hazy and new vessels appeared. The intraocular pressure was low—5 mm. Hg (Schiøtz) (fig. 1—O.D.). One month after the operation the wire was seen, totally displaced into the anterior chamber. Finally it fell down to the bottom of the chamber and stayed in the angle without producing a marked reaction. The eye was quiet and the cornea cleared.

In the middle of the second month, there was some reaction in the cornea which became turbid and vascularized in front of the implant. With the slitlamp microscope, fine white exudates were detected on the posterior surface of the cornea where the metal touched it. At that time the tension rose to 22 mm. Hg (Schiøtz), probably due mostly to mechanical occlusion of the angle, and stayed there during the 5th and 6th months. Later the eye appeared entirely normal. The tension remained low and continued so until the animal was killed 32 months after the operation.

Fellow eye. The left eye never showed any irritation or signs of sympathetic ophthalmia during the whole course of the experiment. Still, the curve of intraocular pressure (fig. 1—O.S.) followed closely the variations in the tension of the operated eye. When this became higher than normal, the fellow eye also showed a peak of hypertension and then became hypotonic again during the many months of observation.

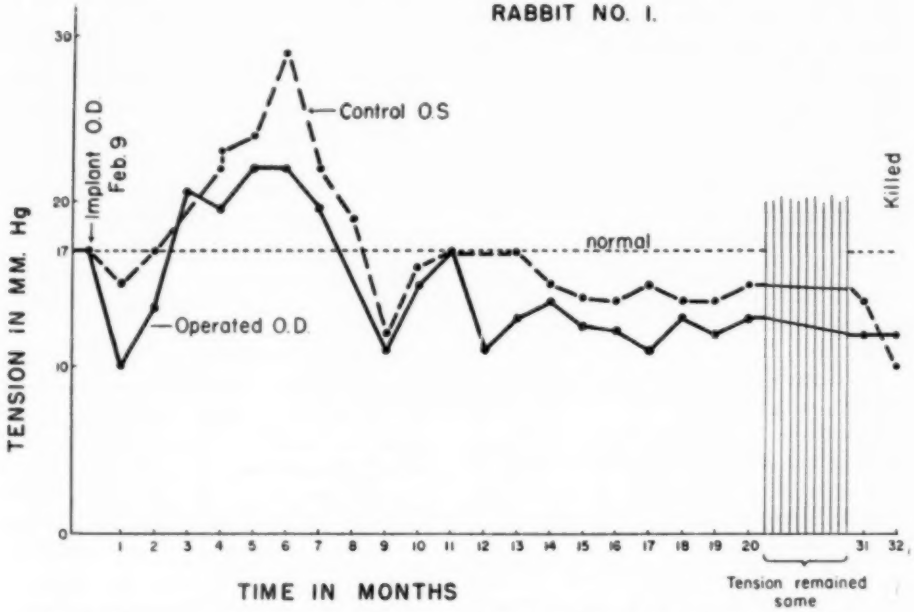

Fig. 1 (Troncoso). Curve of intraocular pressure after tantalum implant in anterior chamber. O.D.—the operated eye—has a full line. O.S.—unoperated eye—a dotted line.

Microscopic examination. The enucleated eyes were sectioned and sent to Dr. Parker Heath in Boston. His coöperation is gratefully acknowledged here.

Right Eye: Sections show a few changes

in the cornea. At the limbus is noted a focal collection of lymphocytes and some blood pigment. There are a few fine vessels growing into the corneal substance about at its middle; and thin nebulous scarring. There are a few pigment deposits on the posterior surface of the cornea. The iris shows postmortem changes, and there is reduction in the lumen of the iris vessels due to exaggerated hyalin changes in their walls. The lens, choroid, retina, and vitreous appear normal. The ciliary body shows some pigment migration and some pigment profileration to a minor degree. There is no foreign body reaction in any of the ocular tissues.

In the left eye Dr. Heath did not find any departures from the normal state. The usual lesions of hypotony were missing and the nervous tissue of the eye was quite intact. We must conclude that the hypotony was only functional.

Comments. 1. A thick, heavy piece of tantalum stayed inside the eye for 2 years and 8 months, producing only a limited local reaction. No foreign body reaction was present.

2. Hypotony was marked all the time, except for a transient rise of tension in the 5th and 6th months.

3. No iritis, anterior synechia, lens opacity, or involvement of the inner membranes occurred as a result of the long stay of the tantalum in the anterior chamber.

4. The fellow eye never showed any sign of sympathetic involvement. However, this eye suffered from a long hypotony which was undoubtedly of a purely functional nature.

EXPERIMENT 2

Trephine operation. One of the drawbacks of the operation of trephining in glaucoma consists in the cicatrization of the conjunctiva and episcleral tissue around and over the hole and the transformation of the conjunctiva into a thick, fibrous tissue, which finally stops any outflow of aqueous into the episcleral tissues.

It occurred to me that perhaps this complication could be avoided by keeping the conjunctiva separated from the sclera over the hole and over the surrounding tissue. I used the tantalum suture, the finest obtainable, 0.003 inch in size and threaded in an eyeless atraloc needle.

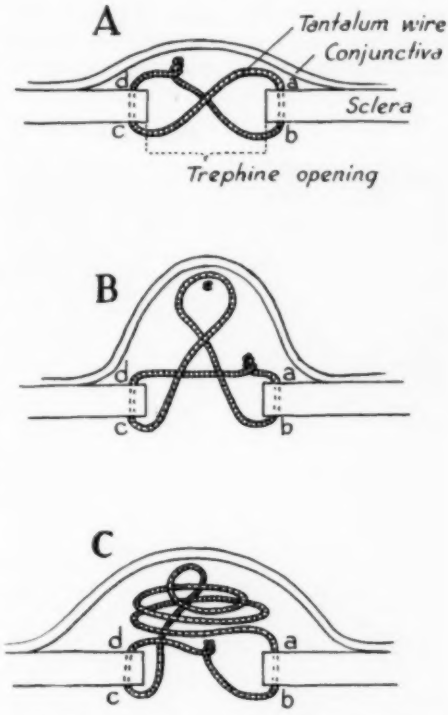

Fig. 2 (Troncoso). Semischematic sections of trephine holes, A, B, C, showing tantalum wire passed with a needle into the sclerocorneal lips, to raise the conjunctival flap.

Technique. After cutting a conjunctival flap in the usual manner, a trephine hole, 2 mm. in diameter, was made at the upper part of the limbus. A needle was passed from within into the thickness of the sclera at the bottom of the hole at b (fig. 2A), brought out at the surface at a, then, crossing the hole, it was inserted, also from within, into the opposite side of the sclera at c, run through the membrane at d and cut through.

The two ends were twisted together over the hole. The flap was then sutured in place covering the wires.

Course. There was little reaction in the eye and two days after the operation the tension was 10 mm. Hg (Schiøtz). The flap cicatrized and the eye appeared normal. The metal loop could be seen with the slitlamp under the slightly raised conjunctiva. After

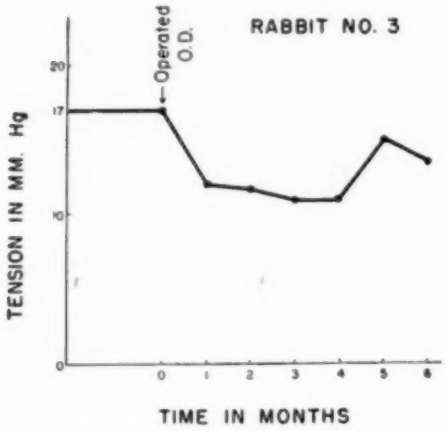

Fig. 3 (Troncoso). Curve of intraocular pressure in rabbit No. 3 after tantalum-wire implant.

two weeks the tension, in spite of gentle massages, came back to normal and the animal was killed.

Microanatomic examination with the slitlamp microscope. The enucleated eye was examined first in front and then from the back of an equatorial section. The wire was clearly located entangled in a mass of cicatricial tissue, which entirely closed the hole, as shown by transparency. The twisted ends of the wire had been separated. One of them protruded from the scar and under the conjunctiva.

EXPERIMENT 3

Assuming that the wire loop had not been raised sufficiently over the sclera to avoid cicatrization, an experiment was made on another rabbit. After making a trephine hole 2 mm. in diameter, the wire was passed from a to b (fig. 2B) and then raised high at the center of the hole where it was twisted into a loop, e, about 3 or 4 mm. high. The needle was again run into the scleral lip from c to d and the two ends twisted together. The conjunctival flap was spread in a tentlike protrusion.

The eye did not show great reaction. The tension lowered to 10 mm. Hg (Schiøtz) and remained low. At the end of the first month after the operation, the metal loop could be seen clearly with the slitlamp under the raised and edematous conjunctiva. The hypotony persisted in this animal for six months at about the same level of 10 mm. Hg (fig. 3).

Unfortunately, a secondary infection supervened at this time and the eye became red. The conjunctiva was very much inflamed and secretion was very great. The tension returned to the normal level and the animal was killed.

Microanatomic examination. The globe was sectioned and placed in a glass jar filled with liquid. When illuminated by transparency with the beam of the slitlamp, it showed that the trephine hole was closed by a semitranslucent scar (figs. 4 and 5). The wires were located, entangled in a mass of cicatricial tissue. The loop was clearly seen, still raised above the level of the conjunctiva (fig. 5, front view). An equatorial section, examined from the back, showed the wires in place inside the hole (fig. 4). At the right, the small loop probably corresponded to a lateral portion of the wire which had cut through the thickness of the sclera.

EXPERIMENT 4

In order to provide more extensive and flat support for the raised flap over the hole, a tantalum wire was passed as follows (fig. 2C). The needle penetrated at the edge of the hole at b; then came to the outer surface of the sclera at a, and was rolled around a probe three times to form a spiral which

remained at a raised level not only over the hole but over the margins on the episcleral tissue. The wire was then run through the sclera again from c to d and finally the two ends were twisted together. The conjunctival flap was then spread out smoothly over the spiral. Reaction was slight in this animal, but the eye remained hypotonic for six weeks only.

Comment. The fact that a trephine hole was kept open and marked hypotony was produced in a rabbit's eye for a period of six months, while in normal eyes the trephine hole closes very promptly, shows that the tantalum wire can prevent cicatrization of the conjunctival flap over the aperture, keeping the episcleral tissue open for a long time. However, the results of these experiments were not uniform. In some animals the hole closed in 4 to 6 weeks, while in others they remained patent from 2 to 8 months.

Fig. 4 (Troncoso). *Microanatomic aspect* from equatorial section of eye of rabbit No. 3 seen from the back (×15).

EXPERIMENT 5

Tantalum Tube. Trephine Operation. In several operations, instead of wire, I used an implant made with the tantalum tube provided by the Ethicon Suture Laboratories. It has a lumen of 1 mm. and very thick walls. With shears, I made a small cylinder 1.5-mm. long. The tube was cut at the two ends and bent to form two lateral flanges or spurs. This implant was placed inside the trephine hole as follows: one spur was first introduced into the aperture, and then the tube was pushed down into the hole, but it appeared too thick and bulky. The conjunctival flap was then sutured, covering the tube.

Fig. 5 (Troncoso). The same eye of rabbit No. 3, seen from the front (×15).

In rabbit No. 5 there was an infection after the operation and the next day the cornea was hazy near the implant and a posterior synechia appeared on the upper side of the pupil. The tension came down to 8 mm. Hg (Schiøtz).

Two weeks later, by the use of atropine

and sulfadiazine, the inflammation subsided, the pupil dilated, and the cornea cleared almost completely. Subsequently the eye returned to normal. The hypotony persisted for nearly two months, with the implant in place, as seen under the conjunctiva with the slit-lamp. Suddenly the tension came back to normal and stayed there in spite of massages of the eyeball and stretching of the conjunctiva over the implant. The animal was killed.

Microanatomic examination. With the slit-lamp the hole in the sclera appears opaque under transillumination. On dissection an anterior peripheral synechia was found below the place of the implant. This had been dislocated and was hanging inside the vitreous, attached to the trephine hole by one of the spurs and by several exudates. The implant looked too heavy and thick. It was probably displaced by the movements of the eyeball.

Experiment 6

Cyclodialysis operation with a thick tantalum tube. A cyclodialysis operation was performed on a rabbit's eye, making a scleral incision about 3 mm. from the limbus, with the purpose of reaching the ciliioscleral sinus in front of the scleral spur. The implant consisted in a tantalum tube with a lumen of 1 mm. (thick walls) and 3-mm. long. One of its ends had been bent at right angles for 1 mm. The tube was introduced into the wound but the bent portion was left outside, in a vertical position, to provide a channel of outflow from the anterior chamber to the episcleral tissue under the conjunctiva.

The day after the operation the reaction was mild. There was some blood on the iris surface. The conjunctival flap was edematous. The tension taken on the fourth day was 5 mm. The eye was very soft and the tip of the implant could be seen under the flap. The eye became quiet. Twenty days later, however, the tension rose to normal. The animal was killed.

Microanatomic examination. In an equatorial section seen from behind, the heavy tantalum tube had been dislocated from its place and moved forward below the ciliary body. It was bound to the processes by white exudates. The scleral hole was closed, as seen by transparency.

Thin-walled tantalum tubes

It being apparent that the heavy tantalum tubes were entirely unsuitable as implants inside the eye, I tried a new metal tube which I made with some very thin tantalum foil —0.00025-inch thick. This was rolled around a hypodermic wire once or twice. The foil being very pliable easily retained its shape.

Technique. I used the following technique. With ordinary scissors a band was cut in the foil, exactly 5-mm. wide for the length of the sheet. This band was rolled over the hypodermic wire. Then, pushing it to the end of the wire, a cut was made on each side in the direction of the axis of the cylinder for 1 mm. If two flanges were desired at this end, the metal was bent at right angles and the shape of the spurs was fashioned with scissors. If only one flange was intended, the other part was cut through. The same process was repeated at the other end of the tube. The implant, being tiny, was kept threaded on the hypodermic wire and placed inside a small glass tube for sterilization.

The tantalum tube could be made of any length and diameter and even when pressure was exerted outside with the thumb and index fingers it proved to be solid and resisted collapse.

The implant could be placed more easily, without risk of losing it, if it was kept threaded on the hypodermic wire until put into the wound.

Experiment 7

Reverse cyclodialysis with fine tube implant. A cyclodialysis operation, performed in the usual way, is difficult to do properly in rabbits. When the scleral incision is made 2 or 3 mm. from the limbus, the knife falls into the ciliioscleral sinus and, if a com-

munication is needed with the suprachoroidal space, a spatula or a knife has to be pushed backward to cut the insertion of the ciliary body to the sclera. If the incision is made on this membrane, 4 or 5 mm. behind the limbus, in order to reach the anterior chamber the spatula has to cut or detach the spur. Because of these reasons I performed cyclodialysis from the anterior chamber backward.

An incision was made in the corneal limbus with a keratome and enlarged with scissors. In the rabbit, the iris protrudes immediately into the wound. No iridectomy was performed on this animal. Opening the corneal wound, a spatula was slid under the scleral lip, hugging it closely to break first the pectinate ligament fibers and then the scleral spur and to separate the choroid from the sclera. The implant tube, with two spurs on the forward end, and threaded in the hypodermic wire, was introduced with a forceps between the ciliary body and the sclera. When securely in place, the wire was withdrawn while the forceps kept the tube in place. Two sutures were placed on the corneal wound to keep the iris back. Eserine (1 percent) and sulfa salve were used.

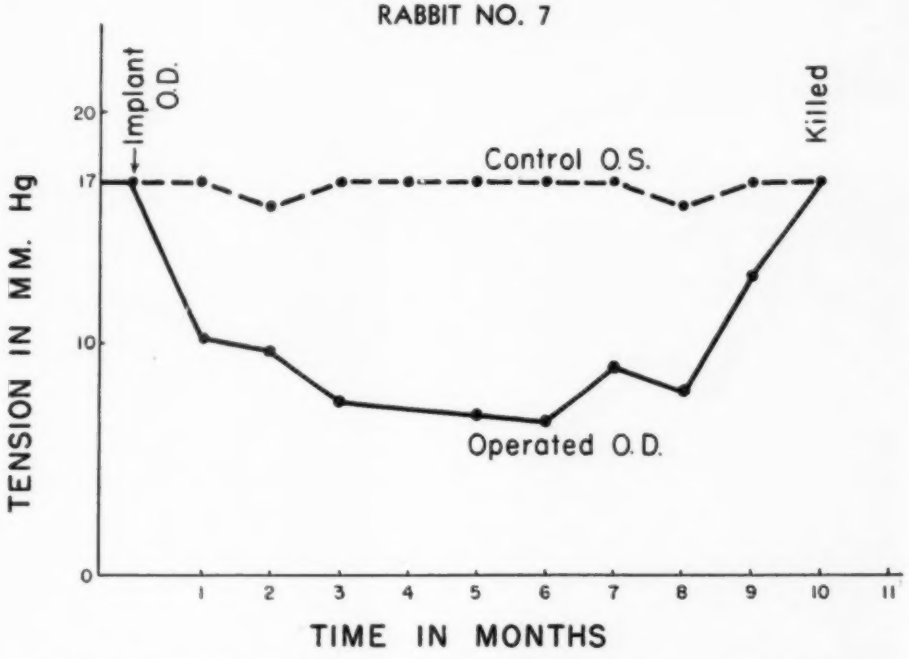

Fig. 6 (Troncoso). Curve of intraocular pressure in rabbit No. 7, after reverse cyclodialysis and implant of a thin-walled tantalum tube.

The reaction after the operation was moderate except that the lips of the corneal incision were infiltrated and there was some blood in the iris. One week later the sutures were removed. Tension was 11 mm. Hg (Schiøtz). The corneal wound, when viewed with the slitlamp, appeared hazy and vascularized; the pupil contracted by eserine. Three weeks after the operation, the eye appeared to be quite normal and the end of the implant could be seen in the anterior chamber. Two months later a small triangular,

white, corneal infiltration appeared and proved to be a scar where an anterior peripheral synechia had developed.

iris involvement. At the end of this time the tension started to rise until it returned to normal and the animal was killed. During

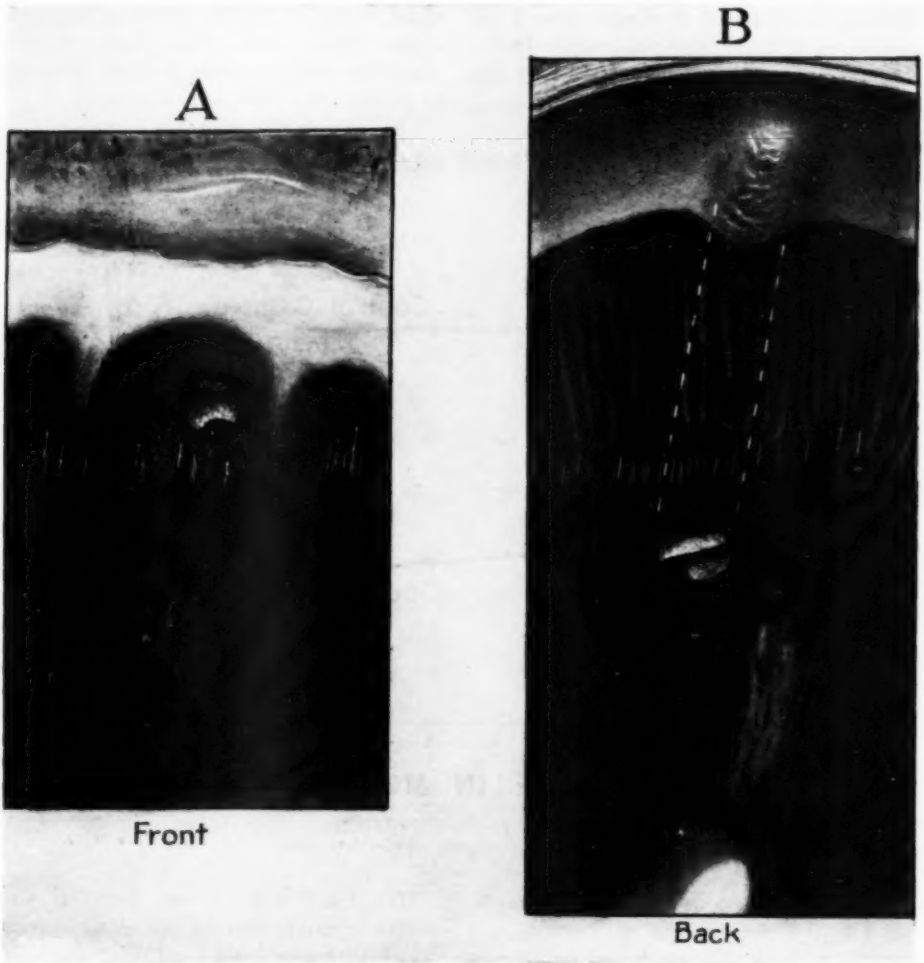

Fig. 7 (Troncoso). *Microanatomic examination of the eye of rabbit No. 7.* (A). The eye seen from in front showing in the iris the anterior end of a tantalum tube (×20). (B) The same eye seen from the back of an equatorial section showing (below) the anterior end of the tube and (above) the posterior end covered with a fine exudate in folds. The dotted lines represent the position of the central portion of the tube.

The intraocular pressure, which had become very low—about 7 mm. Hg (fig. 6)—was kept at this level for eight months without the eye showing any signs of irritation or all this time tension in the fellow eye remained normal.

Microanatomic examination. The enucleated eye, seen from the front (fig. 7A)

showed, on the iris surface, a hole divided into two parts: the one above was the inside of the lumen of the tube, while the lower one was undoubtedly a metal spur.

In the equatorial section seen from behind (fig. 7B) the tantalum implant appeared clearly in two sections. The lower one was the tip of the tube with a spur which rested on pigmented cicatricial tissue. The upper end of the tube was located behind the ciliary processes and the ora serrata. With the light, the metal shone through white, translucent folds of exudates.

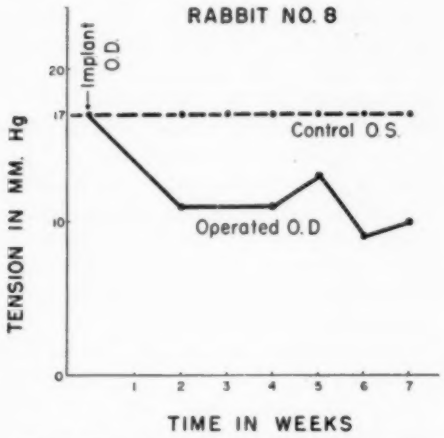

Fig. 8 (Troncoso). Curve of intraocular pressure in rabbit No. 8, after reverse cyclodialysis and implant of a thin-walled tantalum tube.

This tip of the tube lay under the retina and choroid, but no lumen was visible, being probably obtructed by exudates. This will explain the return to normal of the intraocular pressure after so long a hypotony. The processes appeared normal, but at the back of the iris there was a small atrophic spot. The lens was clear.

EXPERIMENT 8

Using the same technique as in former experiments an anterior cyclodialysis, without iridectomy, was performed and a tube implant was inserted from in front between the iris root and sclera. Two corneal sutures were made and the bulging iris pushed back between the sutures with a spatula.

Fig. 9 (Troncoso). *Microanatomic examination of the eye of rabbit No. 8* showing tantalum tube in place between sclera and ciliary body.

Inflammatory reaction after the operation was slight, but at the corneal scar there was some opacification and new vessels were present. An adhesion of the iris to the angle or a peripheral synechia drawing the pupil upward was disclosed 20 days after operation. With the slitlamp, the spurs of the implant could be seen on either side of this anterior peripheral synechia and under the conjunctival insertion.

Tension was low (fig. 8). At the end of the 6th week after the operation the animal became very sick with a pulmonary disease and had to be killed.

Microanatomic examination. The eye was sectioned meridionally on each side of the place of operation. A narrow peripheral synechia was seen clearly on the frontal view with the spurs on each side of the adhesion. Serial lateral sections were made until the implant was reached (fig. 9), and its continuity under the corona ciliaris was fully established. Some of the processes had been drawn forward with the iris into the synechia.

Comments. The fine tantalum tube proved handy, light in weight, and apparently inert as it did not provoke any important reaction on the inner structures. The drainage

from the anterior chamber into the suprachoroidal space was perfect as it kept the intraocular pressure low for 8 months in one rabbit and from 3 months to 6 weeks in others.

Apparently, tantalum induced a process of encapsulation with delicate, white, membranous exudates around the foreign body. The tubes, made of thin foil, were easy to shape and sterilize and stayed in position well.

Conclusions

Experiments in rabbits' eyes have shown that the metal, tantalum, is well tolerated by the inner membranes of the eye and may be kept in position for a long time after cyclodialysis operation and trephining. Tantalum sutures, foil, and tubes have been used. I favor the use of a fine tube made with thin tantalum foil rolled over a hypodermic wire and on which flanges can be fashioned. This tube used in a reverse cyclodialysis operation has produced a hypotony which, in some rabbits, has lasted as long as 8 months.

Addendum

After this paper was written, I found, in the August, 1947, issue of the American Journal of Ophthalmology (Volume 30, page 1033, August, 1947), among the editorials, a brief mention that at the meeting of the Wilmer Residents Association, Dr. Malcolm W. Bick had discussed the subject of "Tantalum implants for glaucoma."

In a personal communication, Dr. Bick kindly wrote me as follows: "Dr. Alfred Maumenee, who is now in California, and I made a complete study of the use of various types of tantalum implants in rabbits and the final phase of this work was completed last summer. It has not been prepared for publication.

"In humans, cases were confined to four patients in whom an implant had been placed in the suprachoroidal space and was permitted to remain there. In all four cases the tension was controlled for about two weeks at the end of which time the tension rose again. It was the feeling of Dr. Friedenwald that this was due to the fact that the cleft became lined with epithelium and no absorption could take place. These implants were buried in much the same manner as your magnesium implants but were sutured through the sclera by means of a 5-0 braided nylon suture which prevented the implant from slipping into the anterior chamber. In three of the eyes the implant was removed. In the fourth case, a patient who has had absolute glaucoma, the implant has remained for over a year and a half without causing undue irritation. The patient complains of ciliary pain from time to time. A small pannus has formed in the cornea adjacent to the area where the implant lies.

"The tantalum implant used in the four patients was a plate. The approximate size was 2-mm. wide, 7-mm. long, and 0.25-mm. thick. The edges were round and highly polished with jewelers' rouge. The implants in rabbits were also plates. However, in the rabbits the plates were brought out through the sclerotomy wound. The reason that this was not done in humans was that our microscopic sections showed a downward growth of episcleral fibrous tissue into the cyclodialysis cleft going forward toward the anterior chamber."

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INVESTIGATION OF THE BLOOD-AQUEOUS BARRIER IN THE NEWBORN*

II. To Inulin

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The present study was designed to learn more about the nature of the blood-aqueous barrier in the eyes of newborn, and to aid in the interpretation of results obtained previously[1,2] in which the concentrations of ascorbic acid in the eyes of newborn were investigated as a function of age. In these earlier studies the concentration of ascorbic acid in the aqueous humor of human fetuses or in the eyes of rabbits or monkeys immediately after birth was found to be approximately that in the blood; that is, 1/10 to 1/25 of that in the adult aqueous humor.

Of the several explanations which might account for the difference in concentrations of ascorbic acid between the adult and infantile aqueous humor, the one considered to be the most likely was that the blood-aqueous barrier in the eyes of young animals and human fetuses was sufficiently permeable so that secreted ascorbic acid could readily diffuse out of the chambers of the eye into the blood stream.

The chief site of this assumed area of high permeability in the young eyes was thought to be the hyaloid system, since a close correlation was observed between the time at which the ascorbic-acid concentration begins to increase and the time at which the hyaloid system regresses, it being well known that the capillary endothelium surrounding the blood vessels in this system, unlike that in the iris, for example, is histologically like that in other parts of the body.

From the observation that the ascorbic-acid concentration in the aqueous humor of monkey eyes continued to rise for several months after the hyaloid system had regressed,[2] it seems probable that the permeability of other portions of the blood-aqueous barrier such as the iris or ciliary body may also be changing in eyes of some animals after birth.

Experimental

Albino rabbits varying from 6 to 14 days of age used in the experiments were obtained from a local dealer 2 to 6 days after birth and were kept with the does. Younger animals could not be employed since the quantity of aqueous humor was insufficient for quantitative analysis.

A solution of 1 gm. of inulin in 10 ml. of isotonic saline was prepared by heating in a water bath at 60° to 70° until clear. The solution could be cooled to room temperature and would not precipitate inulin for at least an hour.

The rabbits were injected intraperitoneally with 2 ml. of the inulin solution cooled to 37°C. The aqueous humor samples were drawn in a calibrated micropipette as previously described.[1] The samples from paired eyes were pooled and quantitatively diluted with 10 to 20 volumes of isotonic saline, depending on the size of the pooled sample. Blood, obtained by heart puncture, was heparinized and the red cells removed by centrifugation. The blood and aqueous samples were taken within 5 minutes of each other.

The inulin concentration in the plasma was determined by the method described by Alving and others[3] as modified by Harrison.[4] This method depends on the formation of a blue color by hydrolyzed inulin and diphenylamine in the presence of strong

* From the Department of Ophthalmology and the Howe Laboratory of Ophthalmology, Harvard Medical School, and the Massachusetts Eye and Ear Infirmary. Supported by a grant from the Foundation for Vision for the study of retrolental fibroplasia.

acid after the removal of other carbohydrates by incubation with yeast suspensions. The aqueous-humor inulin was determined by the same method except that no dilutions were made before precipitating the protein. The amount of color developed was measured in a Beckman spectrophotometer at 620mμ and the concentration calculated from a standard calibration curve. Duplicate determinations checked within 4 percent.

To test directly whether the permeability of the blood-aqueous barrier changes after birth and whether any change in permeability is associated in time with regression of the hyaloid system, experiments were carried out using inulin as a test material. This substance is particularly suitable for testing changes in the permeability of the blood-aqueous barrier, since it is not metabolized and since it will not pass through the blood-aqueous barrier of the adult rabbit eye, presumably because of its relatively large size (molecular weight 5,000).

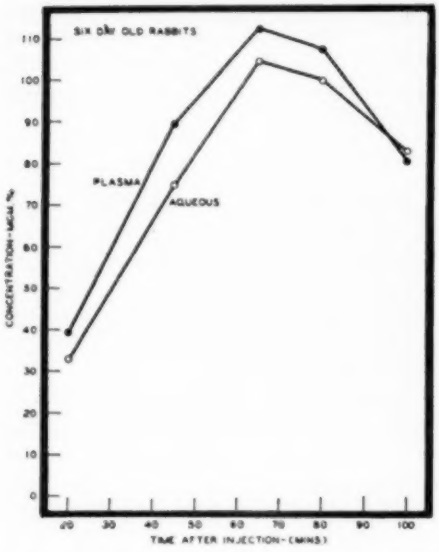

Fig. 1 (Kinsey and Williamson). The relative concentrations of inulin in the aqueous humor and plasma of 6-day-old rabbits at various periods following intraperitoneal injection.

Results

The results of measurements of the relative concentrations of inulin in the blood and aqueous humor at intervals after injection varying from 20 to 120 minutes are given in Figures 1 and 2. It will be seen that a steady state was reached within approximately 60 minutes, and also that the relative concentration in the aqueous humor is considerably higher in the 6-day-old than in the 10-day-old rabbits.

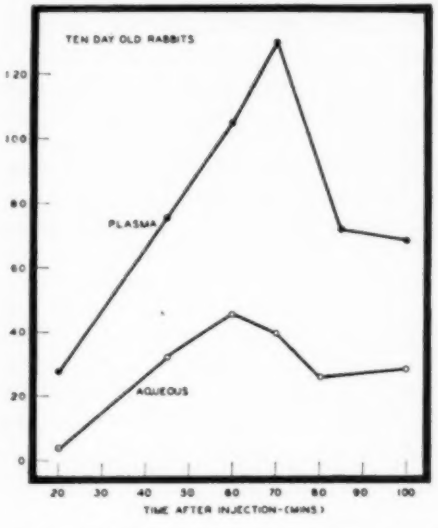

Fig. 2 (Kinsey and Williamson). The relative concentrations of inulin in the aqueous humor and plasma of 10-day-old rabbits at various periods following intraperitoneal injection.

To relate more closely the change in the aqueous-blood concentrations with age, a series of experiments was performed in which samples were analyzed 60 to 70 minutes following injection into animals of varying ages. Using this time interval, the concentrations of inulin in the aqueous humor and blood from animals of varying ages were determined. The results of these experiments are presented in Table 1 and graphically in Figure 3. The latter shows that ratio of concentration decreases rapidly with increasing age of the animal until at

approximately 15 days of age no inulin is found in the aqueous humor.

Discussion

The observation that inulin can diffuse freely into the anterior chamber of eyes of young rabbits clearly supports the idea that the blood-aqueous barrier in young animals is much more permeable than it is in older animals. The decrease in the ratio of concentration of inulin in the aqueous humor to that in the blood indicates that with increasing age there is a progressive decrease in the permeability of the blood-aqueous barrier or, at least, a decrease in the available surface area through which diffusion may take place.

The time period during which the steady-state ratio is changing corresponds with the time of regression of the tunica vasculosa lentis as observed both histologically and with the biomicroscope. The conclusion ap-

TABLE 1

CONCENTRATIONS OF INULIN IN THE AQUEOUS HUMOR AND BLOOD FROM ANIMALS OF VARYING AGES

Age (Days)	Number Animals	Weight (Average)	Plasma Inulin (Average)	Aqueous Humor Inulin	Ratio Aqueous / Plasma
6	4	97	110	102	0.925
8	2	135	78	37.7	0.485
10	2	106	108	41	0.386
14	6	286	98	3.5	0.036

All corrected for small blank.

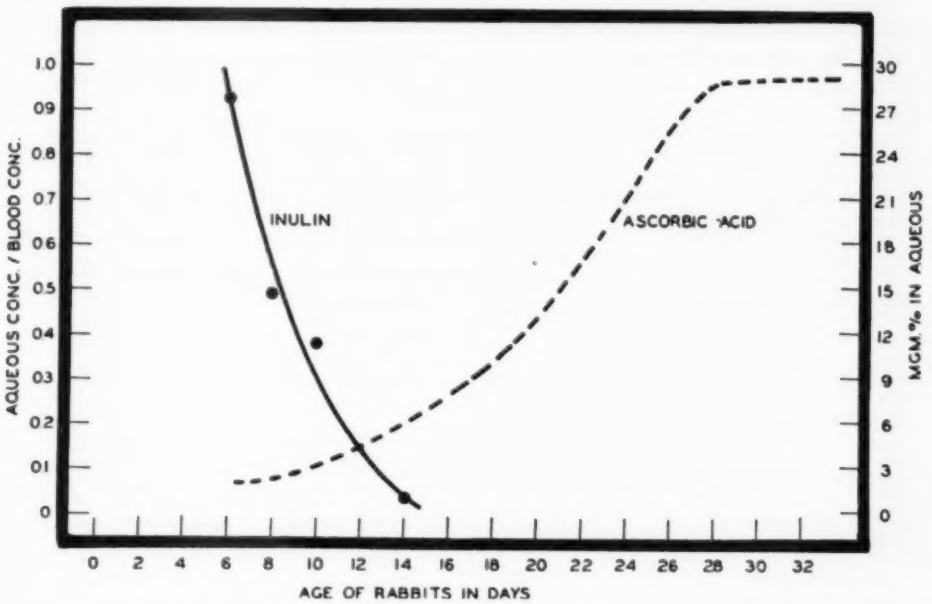

Fig. 3 (Kinsey and Williamson). (Solid line) —— The relative concentration of inulin in the aqueous humor to that in the plasma at steady state for rabbits of various ages. (Broken line) - - - The concentration of ascorbic acid in the aqueous humor of rabbits of various ages.

pears to be warranted therefore that the inulin passes into the eye through the capillary system of the tunica vasculosa lentis and probably not through any other portions of the blood-aqueous barrier.

In view of these results the explanation given previously[1] to account for the low concentration of ascorbic acid in the eyes of young animals appears to be correct; namely that any ascorbic acid secreted into the aqueous humor in concentrations above that in the blood would diffuse back into the blood stream.

It is interesting to consider the implication of the large change in permeability of the blood-aqueous barrier in the eyes of rabbits less than 15 days of age. It follows from the inulin results that in the young eye the concentrations of probably all water-soluble substances but protein are present in the same concentrations as they are in the blood; whereas, in the adult eye the blood-aqueous barrier is such that the concentrations of some of these materials are excluded from the intraocular fluids. Preliminary experiments with fat-soluble compounds, such as vitamin A, show that this difference does not occur.

Summary

From a study of the relative concentrations of inulin in the aqueous humor and blood of young rabbits at various intervals after intraperitoneal injection it was found that a steady state was reached within approximately 60 minutes.

The ratio of the concentration of inulin in the aqueous humor to that in the blood under steady-state conditions decreased from 0.93 to 0.036 between the 6th and 14th day after birth.

The results are explained on the assumption that with increasing age the permeability of the blood-aqueous barrier is changing rapidly or the available surface area through which diffusion may take place is decreasing. This change is ascribed chiefly to the regression of the hyaloid system. The significance of these findings is discussed in relation to previous work in which the concentration of ascorbic acid was followed.

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HARADA'S DISEASE*

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In 1926, Harada[1] described an interesting and rare ocular syndrome which has borne his name since that time. The essential features of this syndrome are: (1) Prodromal symptoms of general malaise and meningeal irritation; (2) a bilateral uveitis of varying severity; (3) bilateral detachments of the retina with spontaneous reattachment; (4) disturbance of the pigmentary and hair systems, including vitiligo, poliosis, and alopecia; (5) lymphocytosis of the spinal fluid; and (6) dysacousia. The syndrome was incomplete in the 12 cases reported; the most common findings being the first three, and the least common the last three.

Since 1941, four cases of this syndrome have been observed in the Wilmer Institute. It is the purpose of this paper to present these cases, and to discuss their possible relationship to the Vogt-Koyanagi syndrome and sympathetic ophthalmia.

REPORT OF CASES

CASE 1

History. H. J., (J. H. H. No. 141208), a 24-year-old white woman, was admitted to the Wilmer Institute in August, 1941, with a history of malaise, anorexia, and fever of several days' duration. This was associated with severe frontal headache, redness of the eyes, and a progressive visual loss of two days' duration. There was nothing significant in the past history.

On physical examination the only positive finding was a posterior cervical lymphadenopathy. Vision was limited to the perception of hand movements at a distance of one foot in both eyes. External examination of both eyes showed normal anterior segments, except for a moderate ciliary congestion.

Ophthalmoscopic examination revealed a few, fine vitreous opacities. The disc and blood vessels were normal. There were many gray, elevated nodules, scattered through the maculas and peripheral fundi. The patient underwent a diagnostic survey in an attempt to establish the etiology of her condition.†

Laboratory studies. This study showed an eosinophilia of 9 percent on one occasion, and 6 percent on another, for which no adequate explanation was found. One mg. of old tuberculin injected intradermally gave no reaction. Uveal pigment skin test was negative. The pathologic examination of a biopsied lymph node revealed hard tubercles, without caseation.

Lumbar puncture was performed. The spinal fluid was under normal pressure, and was clear. There was an increase in the protein content and in the cell count. There were 90 lymphocytes per cubic millimeter. Two subsequent lumbar punctures, done at weekly intervals, revealed 65 and 80 cells per cubic millimeter, all lymphocytes.

An audiogram was performed and showed a 15-percent loss of hearing for spoken voice.

Course. The patient ran an irregularly febrile course, with the highest temperature recorded as 100.9°F. The headache and general malaise persisted for two weeks after her admission.

Generalized subretinal edema appeared

* From the Wilmer Ophthalmological Institute of The Johns Hopkins Hospital and University.

† Diagnostic survey as performed on these patients included complete medical history, physical examination, hemocytology, blood chemistry including determination of the serum albumin-globulin ratio (for sarcoid), Wassermann reaction, urinalysis, X-ray studies of chest, Brucella agglutination, lumbar puncture and study of spinal fluid, otolaryngologic, gynecologic, and dental examinations, sensitivity to Old Tuberculin, bacterial hypersensitivity tests, uveal pigment skin test, and aspiration of subretinal fluid.

and increased until by the 28th day the retina appeared to come forward several diopters. Vitreous opacities obscured the fundi two days later. On transillumination only gray reflexes were seen in the lower part of the pupillary space. These were thought to indicate retinal detachments.

On the 14th hospital day, anterior uveitis of the granulomatous type was first noted. The patient was treated symptomatically. Two months after the onset of symptoms she was discharged.

Vision in the right eye was 20/200 and in the left eye, 10/200. At this time the media were clear, and it was possible to observe the fundi. There was a diffuse mottling throughout the retinas, most pronounced in the regions of the foveas. Absorbing exudates were seen, and pigment deposits were present along the blood vessels.

On slitlamp examination, the anterior uveitis was still present. There was iris atrophy, and the pupils were irregular and bound down with posterior synechias. The aqueous ray was strongly positive, bilaterally.

After a temporary exacerbation, improvement occurred. Over the course of the following year the patient attained a final visual acuity of 20/20 in each eye. There was no evidence of retinal detachments, and there were no changes in pigmentary or hair systems.

CASE 2

History. C. N. (J. H. H. No. 137131), a 38-year-old Negro woman, was admitted to the Wilmer Institute in May, 1946, because of an acute onset of severe headache, rapid loss of vision, and pain in both eyes of one week's duration. There was a history of syphilitic infection, treated 5 months with arsphenamine 5 years before onset of ocular symptoms. Physical examination was negative.

Eye examination. Vision was 4/200 in the right eye, and 2/200 in the left eye. The anterior segments were normal on external and slitlamp examinations. Ophthalmoscopic examination revealed 2 diopters of papilledema. There was marked generalized retinal edema and moderate venous engorgement.

Laboratory studies. The positive findings on survey included a corrected sedimentation time of 24 mm. per hour, a mild sensitivity to 0.01 mg. of old tuberculin injected intracutaneously, and a positive gonococcus complement fixation test. Wassermann reaction was negative. Gynecologic examination revealed an old chronic salpingitis and cervicitis. Uveal pigment skin test was negative. Cerebrospinal fluid showed a cell count of 86 lymphocytes per cubic millimeter and protein content was elevated. A subsequent lumbar puncture two weeks later revealed 46 lymphocytes per cubic millimeter.

Course. The patient's headache became more severe, and posterior cervical lymphadenopathy appeared. On the 3rd hospital day evidence of anterior uveitis was observed in both eyes. Both retinas were elevated about 5 diopters by subretinal and retinal edema. The fundi were a peculiar, waxy, yellowish color. The nerveheads were elevated 5 diopters, and bilateral retinal detachments were noted inferiorly for the first time. These progressed rapidly, and aspiration of subretinal fluid was done on the 5th hospital day, 0.2 cc. of greenish fluid being obtained. This was injected into the anterior chambers of rabbits' eyes, and intracerebrally into white mice. The results were negative.

By the 21st hospital day the anterior uveitis was severe. Vitreous opacities obscured the fundi except for a dim, red reflex. On the 23rd hospital day, there was no light perception in the left eye. The patient was discharged after 6 weeks.

At this time, fundi could not be visualized and anterior segments of both eyes showed an active, exceedingly destructive, granulomatous inflammation (fig. 1). Tension to fingers was very low. The patient showed some clinical impairment of hearing while in the hospital, and a 15-percent loss by audio-

gram. On discharge, large symmetrical areas of depigmentation were present on both shoulders (fig. 2).

When last seen on February 19, 1948, the patient's vision was limited to light perception. The uveitis was inactive. Both pupils were bound down by posterior synechias and occluded by vascularized membranes. The

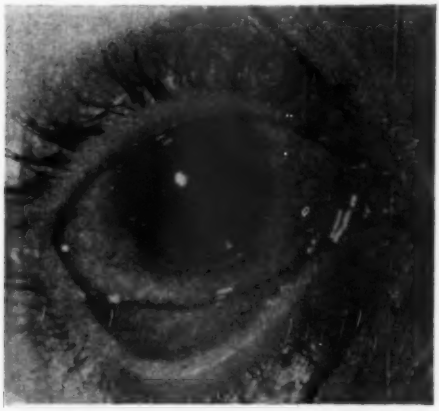

Fig. 1 (Bruno and McPherson). *Case 2.* External view of anterior segment on discharge examination. Uveitis was active, and both pupils were bound down by posterior synechias and occluded by vascularized membranes.

irides were grossly atrophic and markedly depigmented (fig. 3).

CASE 3

History. A. W. (J. H. H. No. 141208), a 19-year-old Negro girl, was admitted to the Wilmer Institute in June, 1947, with the complaint of blurred vision and pain in both eyes of 4 weeks' duration. She had been seen in May, 1947, in the outpatient department where the diagnosis of episcleritis was made, but had not returned until the day of admission. Physical examination revealed a normal, young adult female, six months pregnant.

Eye examination. Vision in the right eye was 20/30 and in the left eye, 20/70. External and slitlamp examination of the right eye was completely negative. Ophthalmo-

Fig. 2 (Bruno and McPherson). *Case 2.* Large, symmetrical areas of depigmentation on the back and shoulders.

scopically the disc was hyperemic and the macula appeared gray and edematous. The veins were somewhat overfilled.

The left eye showed moderate pericorneal injection and evidences of mild anterior uveitis. There was marked blurring of the neuroretinal margin, with loss of physiologic cupping. The edema of the nervehead extended into the surrounding retina. There was marked overfilling of the retinal veins and an elevated yellow nodule was present between the disc and macula.

A complete medical survey did not reveal any cause for the disease. The sedimentation

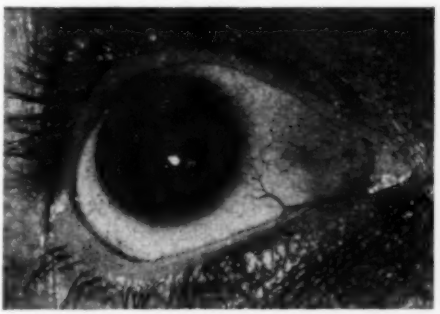

Fig. 3 (Bruno and McPherson). *Case 2.* External view of anterior segment one year later. Uveitis was inactive, pupils were secluded and occluded, and a depigmentation of the irides had occurred.

rate was increased. Uveal pigment skin test was negative and lymph-node biopsy showed only lymph-node hyperplasia. Lumbar puncture showed a normal spinal fluid with only two cells present.

Fig. 4 (Bruno and McPherson). *Case 3.* Bilateral poliosis, with patches of vitiligo involving the eyelids.

Course. The right eye developed a diffuse retinal edema similar to that in the left eye. Bilateral detachments of the retina appeared on the second hospital day. These progressed in both eyes to total detachments by the 17th hospital day. Four-and-one-half weeks after admission, only a dark reflex could be obtained in either eye. Vision in the right eye was restricted to hand motions and in the left eye to light perception temporally.

Because of the relentless course of the disease, it was decided to interrupt pregnancy. Hysterotomy was performed 18 days after admission. This had little apparent effect on the patient's ocular condition. Shortly after operation an intense anterior uveitis developed. As this cleared the elevated retina could be dimly seen in both eyes with a +20D. lens. Audiograms taken at this time showed a 15-percent and 18-percent loss of hearing in the right and left ears.

The patient was discharged and not seen again for three months. When she returned, the uveitis in both eyes was still active. Vision in both eyes was limited to perception of hand motions at one foot. The fundi could not be seen. Poliosis and vitiligo of both lower lids was present (fig. 4), and there was an area of alopecia on the vertex of the skull (fig. 5).

CASE 4.

History. M. J. (J. H. H. No. 359518), a 19-year-old Negro girl, was admitted to the Wilmer Institute in October, 1947, with the complaint of poor vision in both eyes. The present illness began four weeks before admission when the patient developed a general malaise. Three weeks prior to admission vision began to fail and the patient developed severe frontal headaches. One week prior to admission she became febrile and vision failed rapidly.

Past and family histories were essentially negative. Physical examination on admission

Fig. 5 (Bruno and McPherson). *Case 3.* The area of alopecia which occurred at the vertex of the skull. The new hairs are growing in white.

revealed a healthy, young Negro female, two months pregnant.

Eye examination. Vision in both eyes was restricted to light perception. External examination of the anterior segments was negative. Both fundi showed a diffuse vitreous haze. The nerveheads were edematous and surrounding retinal details were ob-

scured by retinal edema. The veins were overfilled. Retinal detachments were present inferiorly.

Complete medical survey revealed no possible etiology for the ocular condition. Spinal-fluid examinaton was negative and there was no lymphocytosis. Uveal pigment skin test was negative. Audiometer showed a 10-percent loss of hearing in the right ear and a 15-percent loss in the left ear.

Course. Heavy vitreous opacities appeared shortly after admission. The retinal edema progressed, giving both fundi a yellow, waxy appearance. The detachments increased in height and size and by the 11th day of hospitalization the fundi could no longer be visualized. On the 9th day of hospitalization aspiration of subretinal fluid was performed. The fluid was inoculated on chorioallantoic membranes of chick embryos and cultured anaerobically. The results were negative.

Fig. 6 (Bruno and McPherson). *Case 4.* Poliosis, with patches of vitiligo, involving both eyes.

The patient was discharged after 25 days of hospitalization with little change in her condition. Vision was 3/200 in both eyes. The patient returned two months later. At that time there was little change in her ocular picture, but she had developed vitiligo and poliosis involving the lids (fig. 6).

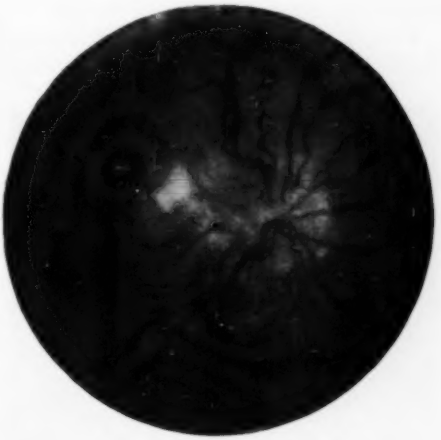

Fig. 7 (Bruno and McPherson). *Case 4.* Left eye. The fundus showed irregular areas of pigmentation and widespread retinal atrophy.

The patient was seen on March 22, 1948, five months after discharge. The vitreous had cleared so that both fundi could be seen (fig. 7). Irregular areas of pigmentation were present and there was widespread retinal atrophy. The retina had reattached spontaneously in both eyes. Vision was limited to counting fingers at two feet. There was no active uveitis present, although moderate iris atrophy and posterior synechias were noted.

Comment

Case 1, H. J., demonstrates the symptom complex and clinical course which typify the "classical" cases described by Harada. The onset of an acute, diffuse, exudative choroiditis, associated with symptoms of cerebral irritation and the appearance of retinal detachments, is characteristic. It is true that the fundi were obscured before the retinal detachments could be observed, but the gray reflexes in the pupillary space seen at this time undoubtedly indicated detachments of

the retina occurring in the inferior aspects of the fundi. The increase in protein and the number and cell type in the cerebrospinal fluid point to meningeal involvement. Here, the anterior involvement was light, and the final visual acuity returned to normal.

Case 2, C. N., also showed the acute, characteristic onset of general and ocular

Fig. 8 (Bruno and McPherson). *Case 4.* Right eye. Transient hyphemia, occurring spontaneously, many months after the onset of original symptoms.

symptoms. Her course was complicated by the development of hypotony, severe anterior uveitis, and the formation of cataracts. The fundi could not be viewed to ascertain if the retinal separation ever receded. But the fact that the left eye had lost all light perception for a week or more, and that light perception and projection returned, indicates the probability that the retinas became reattached. Vitiligo appeared in this patient after the onset of a severe anterior uveitis.

Case 3, A. W., too, was typified by the acute onset of an exudative chorioretinitis, with rapid loss of vision, and the appearance of bilateral retinal detachments.

This case is worthy of comment because pregnancy was interrupted. This was done on the possibility that the retinal detachments might be due to an atypical eclampsia, although the patient gave no clinical evidence of this state. Other forms of therapy had been of no avail and, in view of the rapid advance of symptoms from bad to worse, it was felt that this might be of some benefit to the patient. The fact that this procedure did not appreciably alter the ocular picture indicates that eclampsia was not the factor.

Another point of interest in this case is the delayed onset of the anterior uveitis, which was severe and quite similar in its picture to that in Case 2. With the advent of the involvement of the anterior uvea, depigmentation took place in the skin and eyelashes. Alopecia occurred shortly afterward. It is interesting, too, that the patient presented no findings in the cerebrospinal fluid, as did Cases 1 and 2.

Case 4, M. J., is a transition between Case 1 and Cases 2 and 3, combining some features of each. The prodromal history was prolonged and intimately associated with the period of most rapid visual loss. This was prior to the outpatient department visits, and it is quite probable that, if she had been seen at that time, there would have been signs of meningeal irritation, as shown by increased protein and cells in the spinal fluid.

The onset of ocular symptoms was similar to that in the other three cases, but at no time was the anterior uvea more than mildly involved. The media are now clearing, and the patient has developed vitiligo and poliosis.

A tendency for spontaneous hyphemia has been observed in Cases 3 and 4 within the last few weeks, many months after the onset of the original symptoms. In Case 3 this has tended to persist, but this hemorrhage cleared rapidly in Case 4 (fig. 8). This patient was pregnant, as was the one in Case 3, but it is interesting to note that this apparently had little effect on the course of the disease and was not responsible for any retardation in recovery.

In the further evaluation of these cases, it is striking that three were seen in Negro women, all from the same city, within a period of one year. This is quite a high incidence of a relatively rare syndrome, unless we can presuppose that we have seen a

small epidemic due to some infectious process. Another interesting fact is the presence of a subclinical deafness in all four cases, as shown by audiometer readings.

This disease shows a wide geographic distribution, cases having been reported from Japan, Europe, South America, and the United States. It does not show a predilection for any specific race or sex. The patients reported in this series varied in age from 19 to 38 years; most of the previously reported cases have been in patients from 30 to 50 years of age.

Etiology

The specific etiologic factor in this disease is unknown. The four possible etiologies which have been proposed for this syndrome are: (1) Syphilis, (2) tuberculosis, (3) hypersensitivity to uveal pigment, and (4) a virus.

Serologic examination was carried out in all cases in the present series and found to be uniformly negative. In Case 2, in which there was a positive history of a luetic infection, there was a period of five months' treatment with arsphenamine, long before the onset of the ocular symptoms. Syphilis, therefore, cannot be considered as a causative factor in these patients.

Tuberculin tests were made on each patient as part of the diagnostic survey. Only one, namely, Case 2, was sensitive, and she gave a mild reaction to 0.01 milligram of old tuberculin injected intradermally. There were no other findings to substantiate the diagnosis of ocular tuberculosis in this patient. Chest X-ray studies were negative. This syndrome was ascribed to tuberculosis by Okamura.[2] His opinion was based on a histologic examination of one iris biopsy. Furthermore, the clinical course, the appearance of the fundi, and the final results of this process are not at all characteristic of ocular tuberculosis. In Case 1, the lymph-node biopsy showed hard tubercles with no caseation. The patient was insensitive to 1 mg. of old tuberculin and her chest X-ray film was negative, findings which are more suggestive of sarcoid than tuberculosis.

Because of the clinical resemblance of Harada's disease to sympathetic ophthalmia, Weskamp[3] made use of Peters's[4] suggestion that hypersensitivity to uveal pigment may play some part in the production of the inflammation. This is simply an application of Elschnig's theory of the etiology of sympathetic ophthalmia to a disease which resembles it in many of its manifestations. Even if hypersensitivity to uveal pigment was present in these cases, it certainly seems that some other factor would have to be present to initiate the process. In the present series we were unable to demonstrate hypersensitivity to uveal pigment by skin biopsy in any of the cases.

A theory which has many adherents, but little proof for its support, is the virus etiology of Harada's disease. Takahashi's work strongly suggested this factor.[5] He studied both the vitreous and spinal fluid of patients in Harada's series.

Bacteriologically sterile vitreous was injected into the cisterna of 5 rabbits. In 2 rabbits an optic neuritis and uveitis developed; in 29 days in one case, and in 50 days in another case. The cerebrospinal fluid of a patient with Harada's disease was injected into the vitreous of a rabbit eye, producing an inflammatory reaction in both eyes within 12 to 16 days. The brain of a third rabbit which had been inoculated with human vitreous was injected into an uninfected rabbit. The latter developed an optic neuritis and an iridocyclitis within 2 days.

Controls inoculated with human serum and the cerebrospinal fluid of tabetics gave no reactions. From these experiments Takahaski concluded that the etiologic agent of the disease was probably a virus, and that it was transmitted by way of the optic nerve. He postulated a relation between this virus and the causative agent of herpes.

Tagami[6] injected the subretinal fluid of a patient with Harada's disease into the vitreous of rabbit eyes and produced a uveitis

Fig. 9 (Bruno and McPherson). A case of vitiligo in a patient with the Vogt-Koyanagi syndrome.

which he could transmit for three generations. Further, he studied some of these eyes histologically and observed a diffuse infiltration of the choroid, similar to that in sympathetic disease, but without the formation of giant cells. There was detachment of the choroid and retina by a serous or fibrinous exudate. The pigment epithelium was degenerated, but there were no changes in the neuroepithelium of the retina.

Malbran and Muhlmann[7] used vitreous of a patient with Harada's disease, injecting it into the subarachnoid space of rabbits, and produced optic neuritis and uveitis. Using the spinal fluid of the same patient, they inoculated one eye of a rabbit. This resulted in an intraocular inflammation which appeared in the other eye in 12 days.

Subretinal fluid was obtained from Cases 2, 3, and 4 of the present series. This was found to be bacteriologically sterile, and was used for virus studies. Some of the fluid was injected intracerebrally into white mice. These animals were killed after varying intervals of time and transfers of infected brain tissue to uninfected mice was performed. The chorioallantoic membranes of 14-day-old chick embryos were inoculated with more subretinal fluid, and transfers were made to other embryos of varying age after a period of 5 to 7 days. The anterior chambers of rabbit eyes were inoculated with subretinal fluid and spinal fluid of patients. In all these experiments no virus could be grown.

This failure to confirm what other observers have reported may be explained in several ways. It is a well-known fact that a virus must be isolated early in the course of any disease in order to obtain positive results. Perhaps the inoculum was not obtained early enough in the cases of this series. Another explanation lies in the possibility that previous workers may have isolated a virus quite often found in the rabbit and transmitted this from animal to animal. None of the work reported is conclusive,

Fig. 10 (Bruno and McPherson). A case of vitiligo in a patient with sympathetic ophthalmia which followed an iridencleisis done for control of glaucoma.

since no agglutinins or other antibodies were ever demonstrated in experimental animals or in patients. However, the evidence for a virus etiology of this condition is the only evidence supporting any of the etiologies so far proposed.

What is the relation of Harada's syndrome to the Vogt-Koyanagi syndrome and to sympathetic ophthalmia? Certainly many of the clinical signs of the three are similar and the syndromes frequently overlap. Poliosis and vitiligo are essential features of the Vogt-Koyanagi syndrome (fig. 9) and have been observed in sympathetic ophthalmia (fig. 10).

Nettleship[8] reported a case of poliosis in sympathetic ophthalmia as early as 1884. Numerous other incidents of this occurrence have been reported subsequently. Two cases of the present series and 8 of Harada's original series developed this phenomenon (see table 1).

Alopecia is an integral part of the Vogt-Koyanagi syndrome and in 29 cases reported after Koyanagi's series up to 1941,[9] this finding was present in 13. This occurred in 1 of the present series and in 2 of Harada's cases.

Dysacousia is a frequent finding of the Vogt-Koyanagi syndrome and occurred in all the cases of this series. It was present in 4 of Harada's 12 cases. This finding was reported by Komoto,[10] in 1912, in a case of sympathetic ophthalmia; also by Cramer, in 1913.[11]

Optic neuritis, retinal edema, retinal detachments, although rare, have been described in the Vogt-Koyanagi syndrome.[9] There are occasional findings of sympathetic ophthalmia. Spinal-fluid changes while more common in Harada's disease have been described in both of the other conditions.[12]

The bilateral granulomatous uveitis is characteristic of all three conditions. In the Vogt-Koyanagi syndrome and in sympathetic ophthalmia, it is identical in its cellular characteristics and clinical course. In Harada's syndrome, however, it tends to involve the posterior segment more severely than the anterior, and consequently leads to early retinal detachments which are relatively less common in the other two conditions.

Because of the many clinical resemblances of these three conditions and the tendency for them to overlap, it is possible there is some common etiologic factor in all but there is no indication what such a specific

TABLE 1

PHENOMENA PRESENT IN HARADA'S AND PRESENT SERIES OF CASES

	Harada's Cases	Case 1	Case 2	Case 3	Case 4
Bilateral uveitis	12	+	+	+	+
Bilateral retinal detachments	8				
A—With reattachment	8	+			+
B—Without reattachment	0		±	±	
Poliosis and vitiligo	8	−	+	+	+
Alopecia	*	−	−	+	−
Prodromal symptoms	5	+	+	+	+
Spinal fluid changes					
A—Lymphocytosis	5	+	+	−	−
B—Increase in protein	7	+	+	−	−
Dysacousia	4	+	+	+	+
Uveal pigment skin test		−	−	−	−
Race and Sex		WF	CF	CF	CF
Culture of subretinal fluid	not done	not done	negative	negative	negative

* Specific number of cases not given.

factor may be. If it is a virus, it has not yet been recovered.

Summary

Four cases of Harada's disease are reported. The etiology and relationship of Harada's disease to the Vogt-Koyanagi syndrome and sympathetic ophthalmia are discussed. It seems possible that there may be some common etiologic factor responsible for all three conditions.

The Johns Hopkins Hospital (5).

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Ophthalmic Miniature

Nothing gives dexterity in the use of the ophthalmoscope so quickly and so effectively as an attempt to draw what is seen, and nothing gives ability to recognize details with accuracy and perceive every feature presented, as a habit of drawing does. Yet ophthalmoscopic drawing is hardly ever practised. It is supposed to be difficult, but it is neither difficult nor does it need any ability or facility for ordinary drawing. The process is within reach of every student.

Gowers, *Medical Ophthalmoscopy*, 1890.

OCULAR CYSTICERCOSIS*

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Penido Burnier, on May 15, 1915, one year after the establishment of his eye clinic in the city of Campinas, forerunner of the institute which bears his name, diagnosed his first case of ocular cysticercus. Since then he kept his interest in this phase of ocular pathology and passed his knowledge and experience to his collaborators, assistants, and visitors, thus making possible the present study of 111 cases observed by the oculists and pathologist of the Instituto Penido Burnier. This work, therefore, represents the results of collective experience with ocular cysticercus.

This presentation is arranged in the following chapters: Historical survey, pathogenesis, casuistics, diagnosis, treatment, prognosis, pathology, prophylaxis, iconography.

HISTORICAL SURVEY

Human helminthiasis and porcine cysticercus have been known since times of greatest antiquity, as revealed by the celebrated Ebers papyrus and the writings of Hippocrates, Aristophanes, and Aristotle. The doctrine of spontaneous generation of worms in the intestinal mucosa was accepted until the middle of the 19th century. The Mosaic prohibition against eating pork must be considered as a prophylactic measure.

Although the preliminary studies of Stenstrupp (1842), Siebold and Dujardin (1845), and Wagner (1848) tended to demonstrate the relations between tenia and cysticercus and the similarity of their respective cephalic extremities, it was only in 1850 that Van Beneden firmly established the origin and interdependence of the two parasites, throwing light on their evolutionary cycles.

The discovery of the first living cysticercus in the anterior chamber of the human eye by Schott and Sömmering of Frankfort, in 1829, must have created a great scientific furor and interest. However, Gescheidt, in 1833, still was defending the doctrine of spontaneous mucosal origin of the parasite, believing that morbid ocular changes preceded its appearance.

Thanks to the precious inheritance of Pereira da Cunha and Guedes de Melo, first teachers of Penido Burnier, and inspirers of his love for this specialty, the library of the Institute possessed the most important ophthalmologic literature of the last century dealing with the subject of ocular cysticercus, common enough especially in northern Germany in the second half of the last century, after the discovery of the ophthalmoscope. Thus it was possible to be familiar with the work of Sichel, Albrecht von Graefe, Alfred Graefe, Hirschberg, de Vicentiis, and other authors of experience who were skilled in the diagnosis and treatment of these cases without the resources of modern ophthalmology.

To Sichel, Sr., we owe not only perfect knowledge of subconjunctival cysticercus of which he made 7 personal observations of the 13 cases recorded up to that time (1859) but also a complete report of the first case of living cysticercus discovered in the anterior chamber of the human eye.

Sichel referred to the observations of Schott and Sömmering who followed the development of the parasite for 7 months and made instructive drawings. The patient, Helena Bauer, the 18-year-old daughter of a

* From the Instituto Penido Burnier. Presented at the III Pan-American Congress of Ophthalmology, Havana, January, 1948.

† NOTE. The translator acknowledges with grateful thanks the assistance of Dr. Antonio Jose de Liz Ferreira in preparing this translation.

shoemaker of Frankfort, concealed from Sömmering her previous visit to Schott, and thus permitted both investigators to publish separately this curious and unique case in the medical literature of that time. The parasite was easily extracted by Schott on July 17, 1829, in the presence of Sömmering and other notables of Frankfort. Hirschberg recorded that the pleased surgeon had the figure of cysticercus cellulosae engraved on his ring and published his daring operation in 1836 in the appendix of a paper on the umbilical cord.

In 1829, before the Congress of German Naturalists in Heidelberg, Sömmering emphasized that the above case represented not only the first case of cysticercus discovered in the human eye but also the first example of the living parasite in a living human. For several years it was considered a unique case, and even in 1859 Sichel said there had not been another such case in which the parasite was so minutely studied and depicted before and after extraction, with the naked eye and with the microscope. The description of Sichel, based on the publications of the two authors, the unpublished data and drawings furnished by Sömmering, and the sketches of Schott deposited in the Museum of the Faculty of Heidelberg, is superior to that of both observers separately.

In 1838, Siebold published the observation of Baum concerning the first case of cysticercus found under the human conjunctiva.

These two ocular localizations were observed on a few occasions in Germany, France, and England. Coccius described a cyst of the vitreous, resembling the cysticercus, barely two years after the discovery of the ophthalmoscope. In 1854, Albrecht von Graefe made the first undisputed observation of cysticercus in the retina and vitreous.

Among von Graefe's numerous writings on this subject, one important paper was published in the *Archiv für Ophthalmologie* (**12**:174(2)1866). This article refers to more than 80 cases observed during a period of 13 years among 80,000 patients. He found the cysticercus 3 times in the anterior chamber, 5 times beneath the conjunctiva, once in the lens and in the orbit, and the remainder in the deep parts of the eyeball. He called attention to the frequency of the cysticercus in other organs, especially the brain, as recorded by pathologists. Virchow found the parasite in two percent of autopsies.

The famous Berlin professor was the first to extract the cysticercus from the vitreous by iridectomy, removal of the lens, and extraction of the parasite in 2 or 3 stages. To avoid delay which was often dangerous to vision, he later performed the three procedures at one sitting. When there was no probability of saving vision, he operated via an equatorial sclerotic incision. Von Graefe was always able to remove the parasite, but sometimes the operation was followed by atrophy of the globe and cataract. He judged as inoperable the subretinal cysticercus, even when some vision remained, because all of his attempts to remove the parasite in blind eyes were failures.

Arlt of Vienna, however, in 1866 succeeded in removing a subretinal cysticercus via a meridional sclerotic incision.

Later, Alfred Graefe, cousin and pupil of the great von Graefe, popularized the extraction of the cysticercus from the retina and vitreous through a meridional scleral incision. From 1877 to 1882, he performed 24 such operations, with success in 16 instances. To Alfred Graefe we are indebted for ophthalmoscopic localization, for this method served him well in localizing the cysticercus and other morbid retinal foci.

Hirschberg's article in 1855, in Eulenburg's *German Encyclopedia of Medicine and Surgery*, gave a good summary of the work of von Graefe and his pupils, and presented a large number of interesting observations.

Alfred Graefe collected about 70 cases of ocular cysticercus among 60,000 patients from his clinic at Halle, and Hirschberg in Berlin encountered 70 cases from a total of

60,000 patients. In the first five months of 1876, among 2,700 new patients, he found the parasite five times in the deep parts of the eyeball. As a result of progress in sanitation and popular education, Hirschberg could only find one new case from 1886 to 1889 among 30,000 patients.

In 1899, De Vicentiis called attention to his 26 cases observed in Palermo and Naples and stated that Hirschberg had informed him that no new cases had been found in Berlin during the previous 10 years among 100,000 patients.

In a paper on "Animal parasites of the visual apparatus," the treatise in Graefe and Saemisch *Handbook*, Kraemer of Zurich, who had studied the problem thoroughly, presented the entire bibliography up to 1898. Bardeli, in 1922, brought new and interesting observations on cysticercus in the deep parts of the eyeball and suggested its destruction by the use of a solution of corrosive sublimate.

In 1918, the subject was propounded in Brazil by Abreu Fialho who published a case of subconjunctival cysticercus and referred to two others in which the parasite was encountered in the vitreous of enucleated eyes. Soon after, there appeared the careful work of Pereira Gomes, "Two cases of intraocular cysticercus, operated upon with success." In the same year Penido Burnier reported his first 6 cases observed during a period of four years. After these reports, others followed, among them Belfort de Matos, in 1929, Pereira Gomes, Aureliano Fonseca, Nicolino Machado, Paula Santos, Abreu Fialho Filho, and other Brazilian authors.

Biancini, in 1923, in an erudite mono-

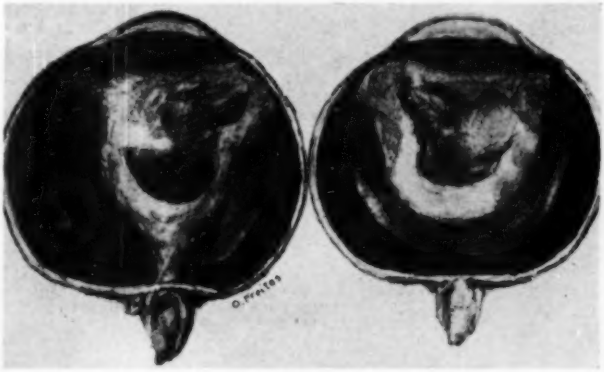

Fig. 1 (Lech Junior). Macroscopic appearance of a globe containing cysticercus. Ophthalmoscopic diagnosis impossible because of organized inflammatory process behind the lens (plastic choroiditis). Umbrella-shaped detachment of the retina. The irregular cavity was partially occupied by the vesicle of the parasite which was well preserved (probably alive). The reactive capsule was characteristic.

Fig. 2 (Lech Junior). Another macroscopic aspect of intraocular cysticercus. The retinal detachment here is more irregular and the cavity occupied by the parasite shows a bilobular appearance in one of the sections. The location was eccentric and the inflammatory process pulled the detached retina over to one side of the globe. In this case, ophthalmoscopic diagnosis was impossible.

graph, claimed that a dead parasite is very dangerous to the ocular membranes. He advised postponing operation when the cysticercus is active and attempting extraction when the ocular reaction showed a decadence of the parasite.

Cosmettatos and Anargyros of Greece and Michail of Roumania reported an increased frequency of cysticercus infestation in several regions of Europe during World War I. Up to 1935, several European authors published 18 new cases to which Michail added 12 more which were discovered in Roumania during the same period of time. When tenia solium exists, the cysticercus tends to be prevalent; both, however, are easily controlled by prophylaxis.

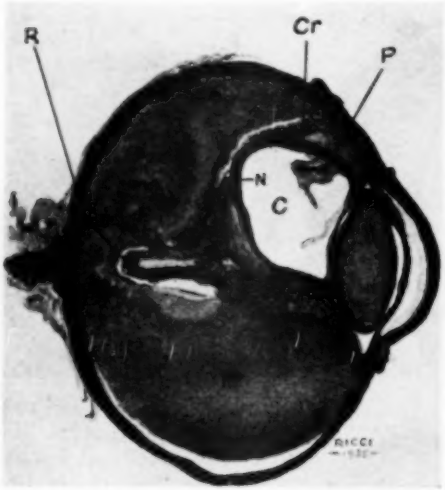

Fig. 3. (Lech Junior). Characteristic appearance of intraocular cysticercus. (Sectioned in celloidin, stained with V. Gieson.) The ophthalmoscopic diagnosis in this case was impossible. Patient was a 2-year-old child. The clinical picture was suspicious of retinoblastoma. Umbrella-shaped complete detachment of the retina, with extensive subretinal hemorrhages. The empty cavity was probably due to fixation fluids which collected as the parasitic vesicle retracted. The purulent and necrotic band (first zone) is wider on one side (N). (C) cavity occupied by the parasite. (P) cysticercus caught in a longitudinal section. (Cr) reactive capsule. (R) retina. (M) hemorrhage.

Biancini, in 1913, considered cysticercus infection to be common in Italy, very rare in the Orient, Asia, Africa, and South America, and more frequent in North America. H. Ward disagreed with the idea, prevalent in Europe, that tenia and cysticercus in the United States were related directly to the extensive hog breeding. American statistics showed not more than a dozen cases of ocular cysticercus. On the other hand, the same

Fig. 4 (Lech Junior). Microphotograph of the same case as Figure 3.

American author attributed, at least in part, the great richness of the German statistics to the accuracy of diagnosis in the well-managed and accessible clinics. At the same time he denied the rarity of the disease in other countries, believing this to be due to deficient observation rather than to absence of the parasite. Rafael Silva showed in his papers that cysticercus is not rare in Mexico, and Lech Junior is convinced that, if carefully investigated, the parasite would be found as frequently in other South American countries as in Brazil. Argentina is probably an exception to this statement, since in its splendid clinics the ocular cysticercus is rare according to the reports of Urrets Zavalia, Adrogué, and other learned colleagues.

Etiology

Tenia solium, whose larva is the cysticercus, belongs to the class of Cestoids, order of Cyclophyllidea, family Taenidiae, genus Taenia, and species Solium.

Its habitat is the small intestine. The definitive host is man, while the pig is its intermediary host, although there are other possible intermediary hosts such as the monkey, the dog, the cat, and even man.

Evolution

Segments of the worm are found in the stools, and rupture to release 30,000 to 50,000 ova. The intermediary porcine host, eating contaminated vegetables or feces, ingests these eggs. The chitinous shell of the ovum is dissolved in the gastric or duodenal juices. The embryos with the aid of their hooks perforate the gastric or intestinal mucosa, and get into the capillaries, especially on the venous side. From there they are carried passively by the blood stream to the tissues and organs of the body. Once the embryos reach the liver or lung, they traverse the capillary network. The cysticercus, rarely found in the liver and lung, is thrown as a living embolus into the circulation where it comes to a halt in the capillaries. In the pig, the embryos localize in the interfascial connective tissue of the muscles, as for example in the pectoral muscles, subscapular muscles, sublingually, in the diaphragm, cardiac muscle, and also in the brain.

After coming to its resting place, the embryo loses its hooks, becomes vesicular, increases in size, and forms a head by evagination of one portion of its wall. Thus forms the mature larva during a period of three months, called the cysticercus cellulosae or cysticercus solium. The larva appears as a globular vesicle, the size of a pea or bean, measuring up to 15 mm. in length and 7 or 8 mm. in width. In color it resembles a transparent pearl in the interior of which is seen a yellowish firm formation called "receptaculum capitis," which consists of the scolex and its neck invaginated like the finger of a glove. At the point in which the membrane is invaginated, is noted a small depression and in the center of this is an orifice through which the head appears when the cysticercus continues to evolve.

At a temperature of 35 to 40°C. the larva develops contraction movements. The head appears resembling the head of the adult worm.

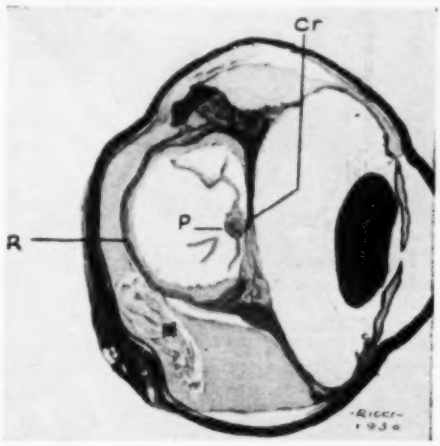

Fig. 5 (Lech Junior). Complete detachment of the retina (R) forming a pocket which involves the reactive capsule and which is closed anteriorly by this capsule (Cr) and by the hyaloid. (P) parasite in transverse section. (M) hyalin masses in the middle of the vitreous. (Section in celloidin, stained with V. Gieson.)

When insufficiently cooked infested pig meat is eaten by a human being, the scolex of the parasite, freed by the digestive juices, becomes attached by its suckers to the intestinal mucosa. It then commences to form segments which are expelled in about three months as mature proglottids in the feces.

Cysticercosis

Infestation. Monteiro Sales stressed in his "New considerations concerning neurocysticercosis" several methods by which man may become infected.

1. Internal autoinfection. Vomiting

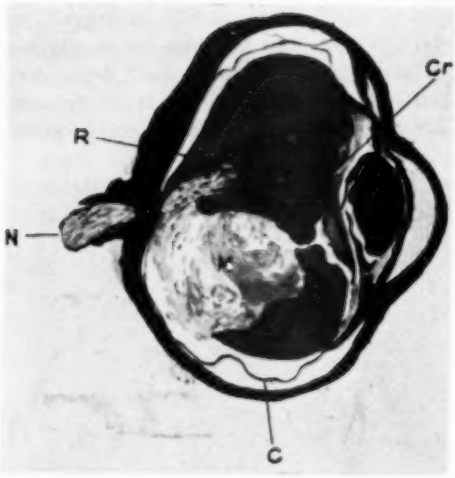

Fig. 6 (Lech Junior). Another case in which ophthalmoscopic diagnosis was impossible (retinoblastoma was suspected). Patient was a 2½-year-old child. The detached retina (R) was pushed to one side by a mass (M) formed by the parasitic vesicle. (Cr) reactive capsule. (C) choroid. (N) optic nerve. (V) vitreous. (Section in celloidin. V. Gieson stain.)

or antiperistaltic movements of the intestines may force mature proglottids into the stomach where digestive fluids may liberate the embryos. These perforate the stomach wall, get into the circulation, and invade different tissues of the body. Rarely, cysticercus and tenia may be found in the same individual. In most cases, cysticercosis does not reveal tenia and cysticercus together, because the intestinal form has been already expelled.

2. EXTERNAL AUTOINFECTION. In these instances the individual who harbors tenia ingests the ova or segments of his own parasite. This occurs in insane people and children.

3. HETERO-INFECTION. This is the usual method. The individual becomes infected by ingesting ova in polluted water, inadequately cooked vegetables, contaminated fruit, or on his own dirty hands, and so forth. In the history, it is important to ascertain the presence of infection in members of the family of the patient. There are cases where one spouse harbored tenia and the other cysticercus.

Migration and Evolution. If an egg reaches the stomach by one of these methods, its shell is dissolved and the embryo passes into the circulation after perforating the gastric wall. The stomach represents the first means of defense against the parasites which are destroyed by prolonged action of the gastric juice. Even in the rare cases of massive infection, it is likely that the majority of the embryos do not survive. When the embryos get into the circulation they act like living, not inert, foreign bodies and come to a stop at points where the caliber of the vessel is narrow or where the flow of blood is slow.

In 1885, Hirschberg thought that infestations were mainly auto-infections, which we now know to be contrary to the facts. Among our 111 cases, only 25 showed tenia and ocular cysticercus simultaneously. We observed in 2 cases the presence of ocular cysticercus representing the larva of tenia solium and the coexistence of an intestinal parasite belonging to a different species (saginata).

Frequency. Ocular cysticercosis is a rare disease. Among 153,528 patients only 111 cases were observed, a proportion of 1:1,383 or a little more than 7 in 10,000.

Localization. The parasite was found in the ocular tissues as follows: 51 in the vitreous, 10 subhyaloid, 44 subretinal, 2 in the anterior chamber, 7 subconjunctival, 1 in the orbit, and 1 subcutaneous in the region of the lacrimal sac. The relative infrequency of the extraocular cysticercus may be influenced by the fact that the extraocular parasite is well tolerated and may exist for a long time before the patient notices its presence and seeks medical advice. When the parasite is located within the eye, the patient is likely to seek medical attention early because of reduced vision from turbidity of the ocular media. The rich vascular network of the choroid as compared with the conjunctival blood vessels may favor the intraocular localization of the parasite. In the

orbit only 1 case of cysticercus was found, in the supero-internal region above the lacrimal sac.

The 7 subconjunctival cases were distributed: 2 in the inferonasal portion, 2 in the external canthal region, 1 in the superior fornix, and 2 in the superonasal area of the conjunctival sac.

When subretinal, the parasite is usually found at the posterior pole, particularly during the first months of infection before the retina is secondarily detached. This predilection may be a function of the diminishing caliber of the arteries which may prevent progress of the parasite toward the periphery. The following chart gives the percentages and locations of the subretinal cysticercus.

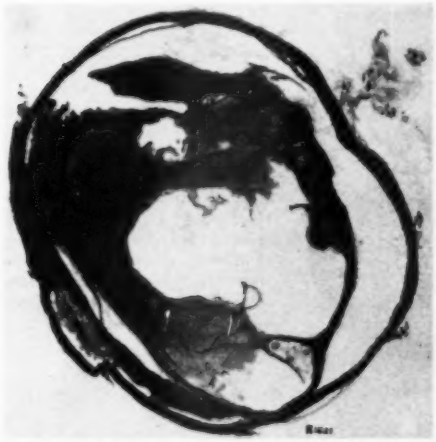

Fig. 7 (Lech Junior). Globe enucleated after operation for complicated cataract. Lens is absent. Anterior chamber very shallow and filled with exudate. Irregular retinal detachment. Parasite easily identified, free in the vitreous with its evaginated scolex resting on the internal surface of the retina. (Section in celloidin. V. Gieson stain.)

		Superior		
	7	0	14	
Nasal	0	39	7	Temporal
	11	11	11	
		Inferior		

After the secondary detachment of the retina has developed, it is observed to be predominantly on the temporal side or inferiorly, because the cysticercus was originally located in the macular region. The same conditions do not hold for cysticercus located in the subhyaloid region or in the vitreous, because the parasite most often settles in the inferior hemisphere as shown in the following chart in which the percentages are recorded.

Fig. 8 (Lech Junior). Same case as shown in Figure 7. Photomicrograph showing the scolex with two suckers and the characteristic crown of hooks lying upon the retina.

		Superior		
	0	0	5	
Nasal	2	5	2	Temporal
	15	42	29	
		Inferior		

The influence of gravity is the likely explanation for the localization of the parasite in the inferior portion of the eyeball when there is no obstacle to its movement.

The central or inferior localization of the

parasite in the anterior chamber is obvious (2 cases).

Vitality and Motility. The diagnosis of ocular cysticercus can only be made when the parasite is alive. Exudative or inflammatory disorganization of the fundus of the eye, when advanced, compromises the vitality and survival of the parasite. Among 97 clinically diagnosed cases of cysticercus, 88 were intraocular. Its vitality could be verified in different ways:

a. Undulating movements of the vesicle.
b. Periodic evagination of the scolex.
c. Motility in relation to the vitreous.
d. Motility of the evaginated scolex.
e. Postoperative examination of the parasite.

The undulating movements, which are most evident when the parasite is in the vitreous, are very slight and can be seen at times only by long periods of observation when the media are sufficiently clear.

The movements of the scolex, on the other hand, are sufficiently noticeable when excited by light, although it is exteriorized only when the cysticercus is in the vitreous, subhyaloid region, or the anterior chamber.

Another evidence of its viability is its change of position within the eyeball during the course of time, moving from its original subretinal site to beneath a fold of the secondarily detached retina, or from one sector of the vitreous to another, or migrating from the vitreous into the anterior chamber even without a vesicle as we had the opportunity to observe in the following spectacular case.

This was the case of a diabetic woman with cysticercus in each eye (Case 77, Chart 108.436). The parasite of the right eye was successfully removed from the vitreous by the transcleral route. The cysticercus of the left eye, situated in the subhyaloid region and previously treated by diathermic cauterization by a colleague without destruction of the organism, was masked by a severe reaction.

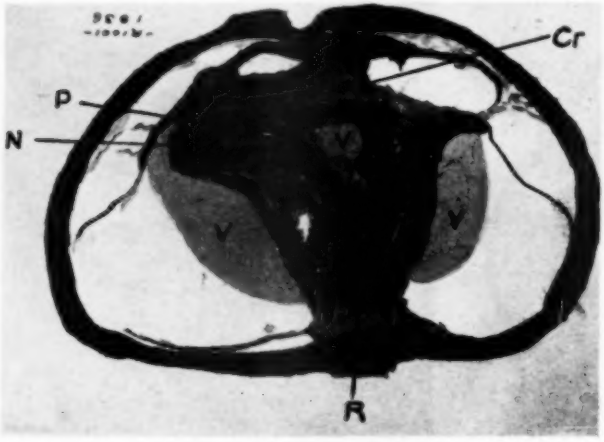

Fig. 9 (Lech Junior). Another case of altered globe with an old complete detachment of the retina (R) and a marked, organized inflammatory process. (Cr) reactive capsule. (V) vitreous. (N) zone of necrosis containing a small area (P) in which hooklets of the parasite were found. (Section in celloidin. V. Gieson stain.)

While the patient was being treated to quiet the inflamed eye, she complained of severe pain in the eye and headaches. Examination showed the presence of a scolex in the anterior chamber attached to the posterior cornea by its suckers. The remaining portion of the scolex was emerging from its base in the iris, without a vesicle. The parasite moved upward by pseudopodlike movements of the sucking cups.

Before it disappeared from view at the opposite side of the iris it was possible to obtain photographs and extract the cysticercus with

forceps through a small corneal incision. During the operation it was possible to verify the strength of the suckers. When the caudal part of the scolex was pulled, the head remained attached to Descemet's membrane and tore loose, so that it was necessary to grasp this portion directly with forceps to remove it entirely.

The motility of the parasite within the eyeball depends upon the fluidity of the vitreous. Even then, the motility is so slight that its surgical removal is but little influenced by the position of the patient. When subretinal, the cysticercus usually remains in its original position for 3 (13 cases) and exceptionally up to 6 months (2 cases) from the onset of symptoms. After this, the parasite obtains the additional space needed for its development in one of two ways:

a. The retina offers some resistance and the parasite takes the path of least resistance in the subretinal space, provoking a secondary retinal detachment without retinal tear, occurring after 3 months (16 cases) rarely in the first month (1 case).

b. More rarely, the cysticercus enters the vitreous directly. In this case, the remains of the retinal tear can be identified. When subretinal or in the retinal tear, the scolex has never been observed ophthalmoscopically to be evaginated.

Age. There is no immunity, although the parasite is less common in patients over the age of 40 years. The youngest patient was two years of age, the oldest was 66. The age incidence in our 111 cases shows:

Fig. 10 (Lech Junior). Photomicrograph of area (P) of Figure 9. The parasite is identified by its hooklets, of which three are seen in the area of necrosis.

AGE	NUMBER OF CASES
First decade	20
2nd decade	30
3rd decade	22
4th decade	24
5th decade	7
6th decade	5
7th decade	3

Sex. Contrary to von Graefe's figures (two thirds of the cases in males), we found that 64 of our patients were females and 47 were males. Probably there is no definite sex predilection.

TABLE 1

OCULAR CYSTICERCUS OBSERVED AT THE INSTITUTO PENIDO BURNIER BEFORE AUGUST, 1947

Case No.	Date	Chart No.	Age	Sex	Eye	Localization		Vision at First Exam.	Onset of Symptoms	Complement Fixation	Carrier of Tenia
1	5/15/15	A.L.	18	F	O.S.	Vitreous	Inferior	C.F. at 1 M.	Unknown		—
2	4/11/17	2.336	30	M	O.S.	Anterior chamber	Central	H.M.	18 mos.		—
3	9/19/17	3.105	31	M	O.S.	Vitreous	Inferolateral	C.F. at 1 M.	6 mos.		+
4	10/13/17	3.251	25	M	O.S.	Subretinal	Not recorded	Nil	24 mos.		—
5	10/22/17	602	36	F	O.S.	Subretinal	Not recorded	Nil	24 mos.		+
6	6/21/18	4.600	9	F	O.D.	Subconjunct.	Superomedial		unknown		Brother
7	10/13/18	5.249	33	F	O.S.	Subretinal	Superolateral	C.F. at 1 M.	1 month		+
8	7/19/19	6.636	6	F	O.S.	Vitreous	Not recorded	Nil	6 mos.		—
					O.D.		Superolateral	C.F. at 10 cm.			
9	6/ 5/21	11.207	51	M		Subretinal			12 mos.		—
					O.S.		Macula	H.M.			
10	1/31/22	12.932	32	F	O.S.	Vitreous	Not recorded	Nil	12 mos.		—
11	5/11/22	13.794	26	M	O.S.	Subhyaloid	Supermedial	H.M.	5 mos.		—
12	5/13/22	13.800	31	M	O.D.	Anterior chamber	Central	H.M.	8 mos.		—
13	7/11/22	14.246	42	M	O.D.	Subretinal	Paramacular	0.4	2 mos.		+
14	4/ 7/23	16.570	38	M	O.S.	Subretinal	Not recorded	C.F. at 2 M.	2 mos.		—
15	11/12/23	18.184	8	F	O.S.	Subretinal	Macula	H.M.	48 mos.		+
16	2/23/24	19.464	30	F	O.D.	Subretinal	Not recorded	C.F. at 2 M.	2 mos.		—
17	3/24/24	19.790	17	F	O.S.	Subretinal	Macula	0.5	3 mos.		—
18	8/26/24	20.920	38	M	O.S.	Vitreous	Inferomedial	C.F. at 2 M.	3 mos.		+
19	10/18/24	21.590	30	F	O.S.	Vitreous	Inferomedial	H.M.	5 mos.		—
20	1/14/25	22.975	60	M	O.D.	Subretinal	Not recorded	0.2	2 mos.		—
21	2/17/25	23.438	52	F	O.D.	Subretinal	Inferior	H.M.	12 mos.		+
22	3/27/25	24.012	17	M	O.D.	Subretinal	Inferolateral	0.5	3 mos.		—
23	5/11/25	24.605	63	F	O.S.	Vitreous	Inferior	H.M.	12 mos.		—
24	1/30/26	27.304	35	F	O.D.	Two in vitreous	Both inferior	C.F. at 1.5 M.	12 mos.		+
25	11/25/26	30.999	8	F	O.D.	Subconjunct.	Inferolateral		1 month		—
26	4/18/27	32.975	30	F	O.S.	Subretinal	Not recorded	H.M.	12 mos.		—
27	9/16/27	34.717	45	M	O.D.	Subretinal	Inferomedial	C.F. at 2 M.	3 mos.		+
28	11/23/27	35.671	9	F	O.D.	Subretinal	Inferior	C.F. at 2 M.	6 mos.		—
29	9/11/28	40.000	23	F	O.D.	Subretinal	Macula	H.M.	6 mos.		—
30	6/29/29	43.824	12	M	O.D.	Subretinal	Not recorded	H.M.	?		+
31	8/ 6/29	44.274	21	F	O.D.	Subhyaloid	Not recorded	H.M.	1 month		—
32	10/29/29	45.283	4	F	O.S.	Subconjunct.	Superomedial		?		+
33	12/ 6/29	45.626	9	F	O.D.	Subconjunct.	Inferolateral		1 month		—
34	1/29/30	46.223	14	M	O.D.	Subretinal	Inferior	H.M.	3 mos.		+
35	6/ 8/30	47.437	43	M	O.S.	Vitreous	Not recorded	C.F. at 1.5 M.	4 mos.		+
36	1/27/31	49.531	18	M	O.S.	Subconjunct.	Superior		2 mos.		Father
37	11/ 9/32	55.425	21	F	O.S.	Subretinal	Not recorded	L.P.	8 mos.		—
38	2/28/33	56.690	12	M	O.D.	Vitreous	Inferomedial	H.M.	12 mos.		+
39	5/12/33	57.374	27	F	O.S.	Vitreous	Inferior	C.F. at 2 M.	2 mos.		—
40	9/30/33	58.856	9	F	O.D.	Subretinal	Not recorded	Nil	7 mos.	++	+
41	1/24/34	60.273	26	F	O.S.	Subretinal	Parapapillary	0.5	4 mos.	+	—
42	2/ 8/34	58.381	66	F	O.D.	Subretinal	Superolateral	0.4	?	++	—
43	3/ 7/34	60.881	27	M	O.D.	Subretinal	Not recorded	H.M.	24 mos.		—
44	4/ 4/34	61.260	21	F	O.D.	Subretinal	Inferolateral	CF. at 2 M.	11 mos.	neg.	—
45	4/14/34	61.397	24	F	O.D.	Vitreous	Inferior	H.M.	12 mos.	++	—
46	5/ 5/34	61.598	24	F	O.D.	Subretinal	Inferolateral	L.P.	36 mos.	+	—
47	7/28/34	62.636	20	F	O.D.	Subretinal	Not recorded	H.M.	10 mos.	++	—
48	4/ 9/35	64.756	37	M	O.D.	Subretinal	Inferomedial	0.1	6 mos.		—
49	4/18/35	66.089	6	M	O.D.	Vitreous	Not recorded	Nil	?		—
50	6/21/35	66.907	32	M	O.D.	Subretinal	Parapapillary	0.5	2 mos.	++	—
51	6/23/35	67.345	6	M	O.D.	Subconjunct.	Lateral		?		—
52	9/19/35	67.374	24	M	O.S.	Vitreous	Inferolateral	C.F. at 2 M.	?	neg.	—
53	11/27/35	69.027	9	M	O.S.	Subretinal	Not recorded	Nil	12 mos.	+	—
54	3/ 2/36	68.611	11	F	O.D.	Subretinal	Not recorded	Nil	4 mos.	++	Sibling
55	3/23/36	70.785	7	M	O.S.	Subconjunct.	Lateral		24 mos.	+	—
56	6/ 6/36	71.787	12	M	O.S.	Subretinal	Not recorded	Nil	6 mos.	+	—
57	7/ 8/36	71.980	9	F	O.S.	Vitreous	Not recorded	Nil	?	++	—
58	9/ 4/36	72.920	7	M	O.D.	Subretinal	Not recorded	Nil	11 mos.	+	Brother and sister
59	10/15/36	73.725	11	M	O.S.	Subhayloid	Inferolateral	C.F. at 20 cm.	2 mos.	neg.	—
60	3/30/37	76.385	19	F	O.S.	Vitreous	Not recorded	Nil	12 mos.		—
61	7/ 7/37	77.858	34	F	O.S.	Vitreous	Inferolateral	C.F. at 3 M.	2 mos.		—
62	7/11/37	77.916	18	F	O.S.	Subretinal	Lateral	C.F. at ½ M.	3 mos.	++	+
63	8/24/38	37.346	25	M	O.D.	Vitreous	Not recorded	Nil	60 mos.	+	+
64	9/19/38	85.097	13	F	O.S.	Subretinal	Not recorded	L.P.	24 mos.		—
65	11/26/38	86.307	10	F	O.S.	Subretinal	Superolateral	H.M.	1 month		—
66	2/ 3/40	93.910	33	F	O.D.	Vitreous	Central	C.F. at 10 cm.	24 mos.	neg.	—
67	4/ 4/40	95.082	32	M	O.D.	Vitreous	Not recorded	H.M.	?	++	—
68	5/13/40	95.721	40	F	O.S.	Subretinal	Central	L.P.	6 mos.	++	—
69	9/14/40	97.830	10	M	O.S.	Subhyaloid	Superolateral	H.M.	?		—
70	2/14/41	100.407	17	F	O.S.	Vitreous	Not recorded	Nil	12 mos.	±	+
71	2/16/41	100.444	15	F	O.S.	Vitreous	Inferomedial	H.M.	2 mos.		+
72	5/27/41	102.306	11	M	O.D.	Vitreous	Macula	H.M.	1 month	±	—
73	6/25/41	102.815	9	M	O.D.	Vitreous	Inferior	Nil	?	neg.	—
74	7/24/41	81.719	2½	M	O.S.	Vitreous	Not recorded	Nil	?		—
75	10/ 8/41	104.509	16	M	O.D.	Subretinal	Lateral	Nil	48 mos.	+	—
76	5/ 6/42	108.168	8	F	O.D.	Subretinal	Macula	C.F. at 2 M.	1 month	++	+
					O.D.	Subhyaloid	Not recorded	C.F. at 2 M.			
77	5/25/42	108.436	50	F					9 mos.	neg.	—
					O.S.	Vitreous	Inferolateral	C.F. at 30 cm.			

TABLE 1—(*continued*)

Case No.	Date	Chart No.	Age	Sex	Eye	Localization		Vision at First Exam.	Onset of Symptoms	Complement Fixation	Carrier of Tenia
78	5/27/42	108.484	11	F	O.S.	Subretinal	Macula	H.M.	3 mos.	±	–
79	7/28/42	109.258	18	F	O.S.	Vitreous	Not recorded	Nil	12 mos.	+	–
80	9/ 9/42	105.775	14	M	O.S.	Vitreous	Superolateral	Nil	9 mos.	+	–
81	5/10/43	114.464	25	F	O.S.	Vitreous	Inferolateral	C.F. at 2 M.	5 mos.	neg.	+
82	5/11/43	114.501	26	F	O.D.	Vitreous	Inferior	C.F. at 50 cm.	11 mos.	neg.	–
83	6/ 5/43	114.978	36	M	O.D.	Two in vitreous	Both inferior	C.F. at 50 cm.	12 mos.	±	–
84	7/ 2/43	115.502	10	F	O.D.	Vitreous	Inferolateral	C.F. at 2½ M.	9 mos.		–
85	7/27/43	116.018	48	F	O.D.	Subhyaloid	Inferomedial	0.6	3 mos.	++	–
86	11/13/43	118.208	24	F	O.S.	Subhyaloid	Inferior	H.M.	6 mos.	±	–
87	6/24/44	118.747	17	M	O.S.	Subretinal	Not recorded	Nil	24 mos.	+	–
88	7/18/44	124.032	28	F	O.D.	Subretinal	Superomedial	0.3	?	neg.	–
89	8/24/44	124.967	11	M	O.D.	Vitreous	Inferomedial	H.M.		neg.	–
90	9/30/44	125.902	6	F	O.D.	Vitreous	Inferior	H.M.		±	–
91	12/12/44	127.629	5	F	O.S.	Vitreous	Medial	Nil		±	–
92	3/ 8/45	130.093	23	F	O.S.	Vitreous	Not recorded	C.F. at 50 cm.		neg.	–
93	6/25/45	132.808	43	F	O.D.	Vitreous	Inferior	H.M.	6 mos.	+	–
94	8/22/45	134.163	23	F	O.D.	Subcutaneous lacrimal sac region			8 mos.	neg.	–
95	9/22/45	134.994	50	M	O.S.	Two in vitreous	Not recorded	0.4	1 month	±	–
96	4/25/46	33.465	50	M	O.S.	Orbit	Superomedial		?	neg.	–
97	7/11/46	142.053	14	M	O.D.	Subhyaloid	Inferolateral	C.F. at 1 M.	3 mos.	+	+
98	7/20/46	142.442	34	M	O.S.	Vitreous	Inferolateral	H.M.	6 mos.	neg.	–
99	8/22/46	143.314	39	F	O.D.	Vitreous	Inferolateral	C.F. at 50 cm.	18 mos.	±	–
100	9/ 9/46	143.761	35	M	O.S.	Vitreous	Inferior	C.F. at 20 cm.	3 mos.	++	+
101	9/17/46	105.859	18	F	O.S.	Subretinal	Inferomedial	0.2	2 mos.	neg.	–
102	9/25/46	144.233	16	F	O.D.	Subhyaloid	Lateral	C.F. at 2 M.	1 month	++	–
103	10/11/46	15.118	32	M	O.D.	Vitreous	Inferolateral	H.M.	6 mos.	±	–
104	1/16/47	147.178	49	F	O.S.	Vitreous	Inferior	H.M.	30 mos.		–
105	2/24/47	145.757	12	F	O.D.	Vitreous	Not recorded	H.M.	3 mos.		–
106	6/14/47	131.709	9	F	O.D.	Vitreous	Not recorded	L.P.	8 mos.	++	+
107	6/26/47	152.003	22	F	O.D.	Subhyaloid	Inferolateral	C.F. at 2 M.	2 mos.	±	–
108	6/29/47	43.824	12	M	O.D.	Subretinal	Macula	H.M.	3 mos.		+
109	8, 6 47	153.322	33	F	O.D.	Vitreous	Inferior	0.3	3 mos.	+	–
110	8/ 8/47	153.421	22	M	O.D.	Vitreous	Inferior	C.F. at 10 cm.	1 month	+	–
111	8/12/47	153.528	15	F	O.D.	Vitreous	Inferior	L.P.	10 mos.		–

Occupation. All of our patients were laborers or farm workers with primitive concepts of hygiene, except for some Dutch workers, the daughter of a wealthy family, and a lawyer. The majority of patients come from rural areas; only exceptional cases arise in urban areas where standards of hygiene are higher.

Preference for the left eye. Our findings were at variance with this preference, as recorded by other observers. We found the distribution between the two eyes to be about evenly divided. Among 111 patients, 56 had cysticercus in the right eye, 50 in the left, 2 were bilateral, 2 had two parasites in the right eye, and 1 patient had two parasites in the left eye. Of the 116 parasites seen in 111 patients, 62 were found in the right eye and 54 in the left eye.

Trauma and site of least resistance. Although trauma was noted in 5 cases, it is probable that this drew the patient's attention to an already infected eye, and that there was no causal relationship.

Secondary inflammatory reaction. During the period of 1 to 3 months after onset of symptoms, the transparency of the media permits the diagnosis of cysticercus wherever it is located. But as time goes on, an exudative reaction develops and the vitreous becomes turbid. In our cases, there were 3 examples of simple iritis, 4 cases of posterior synechias, 11 patients with iridocyclitis, 3 with uveitis, 4 with purulent iridocyclitis, and 1 with endophthalmitis. At times (6 cases) there was so much intraocular disorganization that the attending oculist suspected tumor and advised enucleation, the diagnosis of cysticercus being made by the pathologist. In a few cases, a painful atrophic globe led to the same outcome.

Complications. In addition to the already mentioned complications, of other more or less serious complications, retinal detach-

ment is the most frequent (42 cases). This occurred from migration of the parasite subretinally, or as a consequence of retinal tear when the cysticercus moved from its original subretinal site into the vitreous, or as a complication of operation.

Less frequent were the cases (8 patients) in which the parasite migrated from its subretinal position and was observed before detachment of the retina developed. A late complication is cataract (16 cases). Glaucoma was observed in 2 patients, although more or less hypotension is usually encountered. Atrophy of the globe was recorded on 3 occasions after the clinical diagnosis of cysticercus. The diagnosis was made only on pathologic examination in 12 cases. The above demonstrates how fatal intraocular cysticercus is for vision and even for preservation of the eyeball. In short, to leave the parasite in the eye is to condemn the eye to blindness or total loss.

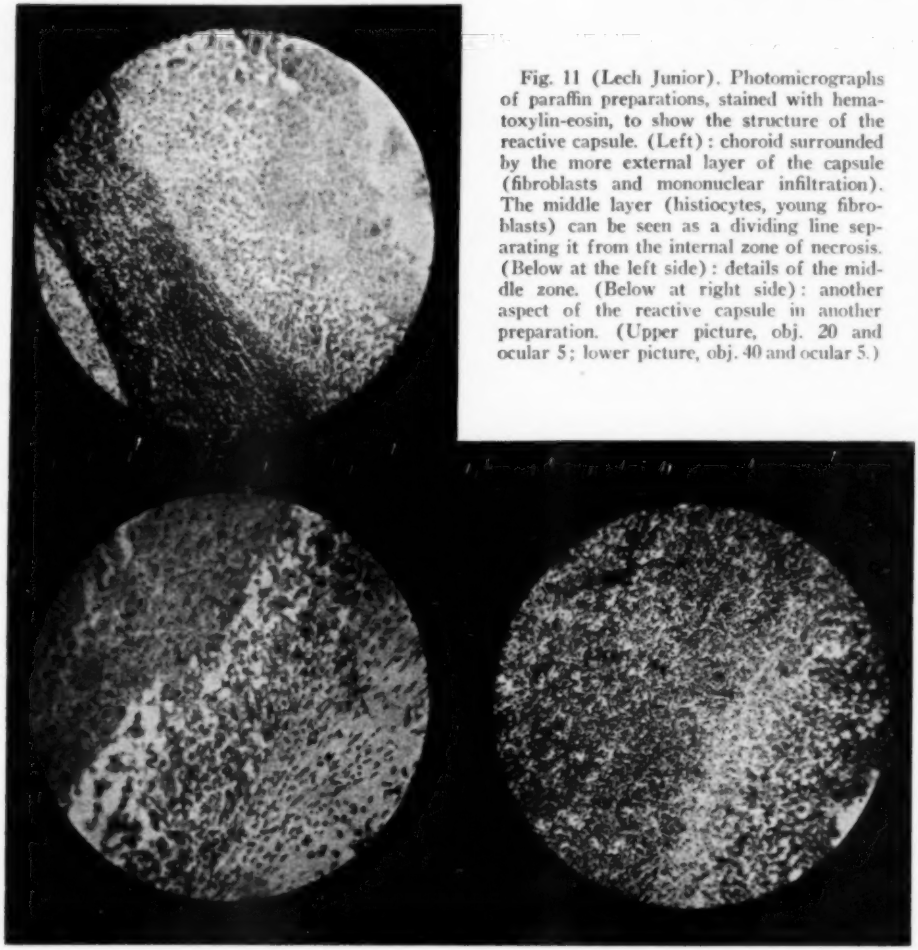

Fig. 11 (Lech Junior). Photomicrographs of paraffin preparations, stained with hematoxylin-eosin, to show the structure of the reactive capsule. (Left): choroid surrounded by the more external layer of the capsule (fibroblasts and mononuclear infiltration). The middle layer (histiocytes, young fibroblasts) can be seen as a dividing line separating it from the internal zone of necrosis. (Below at the left side): details of the middle zone. (Below at right side): another aspect of the reactive capsule in another preparation. (Upper picture, obj. 20 and ocular 5; lower picture, obj. 40 and ocular 5.)

Some oculists advise extraction of the parasite; others, fearing the surgical trauma, try to destroy the cysticercus *in situ* by corrosives, diathermic coagulation, radium, or ultraviolet light. Our experience shows that surgical removal of the parasite may restore vision, put a stop to or ameliorate the harmful process, and prevent further disorganization of the globe. Destruction of the parasite *in situ* does not usually stop the progress of intraocular disorganization. The parasite is harmful, living or dead, as much from its toxins as from the secondary reactions it provokes.

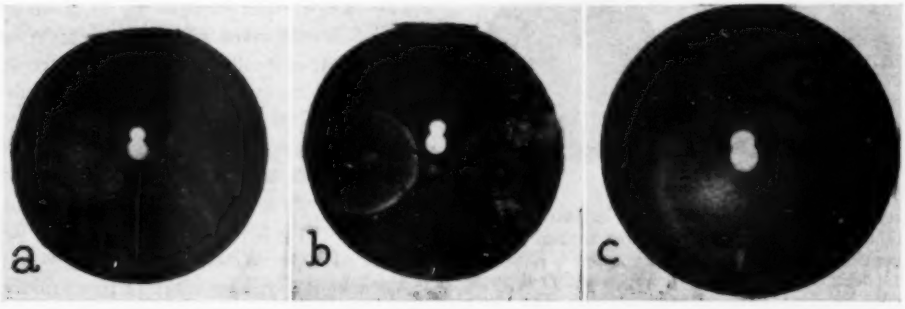

Fig. 12 (Lech Junior). *Chart No. 108.168.* Subretinal cysticercus in paramacular region. (a) Retinography on May 6, 1942, 15 days after the onset of the first subjective symptom (reduction of vision to finger counting at 2 meters). (b) Retinography one month later. (c) Retinography on August 5, 1942. Note the sphericity, the spot in the center of the vesicle corresponding to the scolex, and the iridescent reflex at the periphery, more accentuated in the second picture. Note also the growth of the parasite which has nearly doubled in size during the period of three months. Because of its paramacular location, the parasite was not accessible and surgery was postponed. On October 26, 1942, the cysticercus fell into the vitreous and it was extracted on November 3, 1942. On January 11, 1943, the vision was counting fingers at 3 meters, and there was a secondary detachment of the retina.

Casuistics

Our observations have been gathered into tables. Table 1 contains the essential data recorded at the first examination. The complications, surgical results, and the evolution of the cases treated without operation will be summarized in the sections dealing with surgical therapy and prognosis.

Diagnosis

Symptomatology. The subjective symptoms caused by cysticercus are few and consist of disturbances of central or peripheral vision, depending on the location of the parasite. Since there is no pain, the patient often seeks the oculist only when secondary manifestations occur, such as muscae volitantes, the pains aroused by iritis, or marked reduction in vision from retinal detachment. In these circumstances, there is little probability of restoring vision; the oculist can only try to preserve the eyeball. Cysticercus beneath the conjunctiva, in the subcutaneous tissues, or in the orbit is painless. In the first, there is often localized hyperemia.

Diagnosis. The diagnosis of ocular cysticercosis is difficult because of its rarity and unusual features. Schott was justified in having the figure of the parasite engraved on his ring after he identified the first human intraocular cysticercus and extracted it from the anterior chamber of the patient's eye on July 17, 1829. Another example of enthusiasm evoked by the diagnosis of the parasite is found in the account by C. Cockburn on page 65 of the February, 1946, issue of the *British Journal of Ophthalmology.*

The oculist without experience in this field may see the parasite and not recognize

it. From the histories given by our patients, it appears that exudative choroiditis (when the vitreous is turbid) and detachment of the retina are often diagnosed, and the presence of the parasite is not suspected. We know of a case where an experienced oculist mistook the parasite for leukosarcoma of the choroid and enucleated the eye. In one patient with the diagnosis of a malignant melanoma of

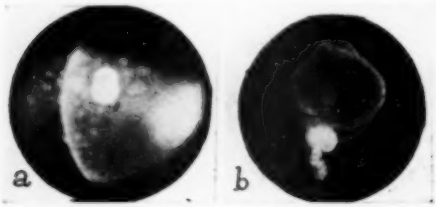

Fig. 13 (Lech Junior). *Chart No. 97.830.* Cysticercus free in the vitreous. (a) Its anterior position prevents view of the entire contour of the vesicle, but the visible sector permits diagnosis (sphericity, central spot corresponding to the scolex, marginal iridescent reflex). (b) The same parasite after extraction.

the choroid, a subchoroidal cysticercus was suspected because of the spherical shape of the lesion, a marginal rainbowlike reflex, and moderate scleral transillumination. A scleral incision in the region of the tumefaction uncovered a cysticercus.

The diagnosis is incontrovertible to the experienced oculist when the ocular media are transparent because of the characteristic appearance of the cysticercus—bluish white spherical vesicle with iridescent marginal reflections and endowed with slight, sometimes imperceptible, undulatory movements. When in the vitreous or in the anterior chamber the parasite may reveal an evaginated scolex. This structure is white, cylindrical and dense, thicker at its base. Under favorable circumstances it is possible to identify the sucking cups and hooks. When the scolex is invaginated it appears like a dense white spot at the center of the vesicle.

When subconjunctival, the parasite differs from a more voluminous lymphatic cyst, which it resembles, by having a central white spot corresponding to its scolex. The diagnosis of the subcutaneous parasite can only be made after its surgical extraction. Our unique case of orbital cysticercus was diagnosed in an unexpected manner. The patient, a lawyer from Campinas, while in his office, felt some fluid running from his left eye down his face. Squeezing his eye with his fingers, a large cyst was forced out of the superomedial part of the conjunctival sac. This cyst was identified as a cysticercus.

The size of the parasite varies with its stage of development and with its location in the eye. It is smaller when situated deeply and early in its evolution. When in the vitreous, behind the lens, its apparent diameter seems much greater and at times its entire contour cannot be seen. The dimensions of the scolex vary with the stage of evolution, the depth of its position in the eye, and the amount of exteriorization of the segment.

At times it mobilizes more or less rapidly. The difficulties of diagnosis increase with the exudative and other secondary manifestations. The experienced oculist may make a definite diagnosis when he glimpses a small sector of the characteristic vesicle through the exudate or between folds of a detached retina.

Where there is much exudation, subconjunctival injections of hypertonic sodium chloride may clarify the vitreous sufficiently to identify the parasite. If the vitreous does not clear, one must observe the course of the ocular process which frequently goes on to atrophy, endophthalmitis, or suspicion of tumor, compelling the oculist to enucleate the globe. Then the pathologist will make the diagnosis.

Often, the suspicion of ocular cysticercus is accentuated when the complement fixation of the blood for cysticercus is positive. Monteiro Sales, our pathologist, says: "The biologic test, although liable to errors of reaction or technique, is sensitive enough to be of value. The blood showed a positive reaction in 89.9 percent of our proved cases of cysticercus (cerebral, subcutane-

ous, ocular). In the proved ocular cases the reaction was less sensitive (73.2 percent of 56 cases of proved ocular cysticercus). Curiously, the negative reactions were often found in eyes showing mild inflammatory or regressive changes. In these cases the diagnosis was easily made with the ophthalmoscope. On the other hand, the serologic reaction was usually positive in cases with advanced intraocular changes. In these the parasite could not be identified, but was found by pathologic study of the extracted tissue or by confirming the presence of the parasite after removing the complicated cataract.[1]

"It is possible that sufficient antibodies to produce a positive serologic reaction are not produced when the parasite is relatively free in the vitreous, or even subretinal, and does not react sufficiently with the host tissues.

"From our statistics 6 percent showed a positive reaction in patients having a positive reaction for syphilis by the Wassermann or Kahn test. Although some authors[2] consider this reaction in the blood of little significance, the possibility of associated luetic and cysticercus infection must be considered in these circumstances."[2]

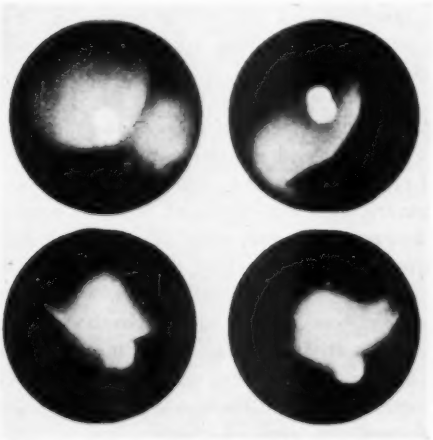

Fig. 14 (Lech Junior). *Chart No. 108.436.* Cysticercus free in the vitreous. Imperfect focus because of vitreous exudate. Diagnosis was made certain by the partial evagination of the scolex.

Treatment

Medical therapy

Medication useful in treating tenia infection is valueless against ocular cysticercosis, for which surgery alone avails.

Fig. 15 (Lech Junior). *Chart No. 116.018.* Cysticercus in the vitreous, adherent to the wall. Photograph of the fundus was made three months after the first subjective symptoms. The extraction was successful.

Surgical therapy

a. Orbital cysticercus. We have had no experience in this variety, because our only case (already described) resulted in spontaneous elimination.

b. Subconjunctival cysticercus. Surgical removal offers no difficulties. Care must be taken to avoid perforating the parasite since this makes its identification more difficult.

c. Cysticercus in the anterior chamber. Extraction of the parasite is relatively easy. The corneal section is made with a Graefe knife rather than with a keratome whose point may injure the vesicle. The incision should be limbal and sufficiently large to permit grasp of the parasite with a toothless forceps. We made an original observation in extracting a moving scolex from the anterior chamber (described under etiology).

d. Subretinal cysticercus. This will be studied in two categories: (1) When the parasite is in its original site; and (2) when, already mobilized, a greater or lesser amount of retinal detachment is present.

1. In its original site. Exact localization is necessary to assure a good surgical result, especially when the parasite is located peripherally enough to permit easy access. Since the small parasite measures only 1½ to 2 disc diameters, there is danger of incising the retina when the scleral incision is located away from the site of the parasite,

Fig. 16 (Lech Junior). *Chart No. 124.032.* A typical vesicular subretinal cysticercus in the nasal quadrant between the 2- and 3-o'clock positions in the right eye.

thus compromising the prognosis of this most favorable type of surgical extraction of ocular cysticercus.

This misfortune occurred in Case 13, Chart 14.246, dealing with a patient with a subretinal parasite, without retinal detachment, and with normal vision. The incision did not coincide with the location of the cysticercus, and the fruitless surgical attempt led to complicated cataract, cyclitis, and finally enucleation of the globe.

In order to avoid similar mishaps, we prefer to wait until the parasite enters the vitreous or moves more anteriorly under the retina. Thus the extraction has a better chance of success, although the prognosis as regards vision is worse. In 1944, Souza Queiroz evolved a very reliable localization technique, employing diathermic coagulation to determine the exact position of the parasite, avoiding the margin of error involved in the perimetric localization, in a case of a small subretinal cysticercus located in the nasal sector of the fundus of the right eye. The following case demonstrates this technique.

Case report

Chart No. 124.032. E. V. S., a 28-year-old, married white Brazilian woman, resident of Guaxupe (Minas) was referred by Dr. Roberto Magalhães Gomes with a diagnosis of cysticercus. She entered the Institute on July 18, 1944. Vision was: O.D., 0.3; O.S., 1.0.

Examination of the right eye showed a typical vesicular subretinal cysticercus in the nasal quadrant in the meridian between the 2- and 3-o'clock positions. The parasite showed movements and an invaginated scolex. Its inferior border corresponded with a horizontal retinal vein. Its posterior border was 2½ disc diameters from the nervehead. The vesicle measured not more than 3½ mm. horizontally. Small hemorrhages were noted between the parasite and the disc. The vitreous, being transparent, permitted a good view of the fundus oculi (fig. 16). Complement fixation for cysticercus was negative.

Operation was performed on July 25, 1944, employing akinesia and anesthesia by retrobulbar and subconjunctival injection of 4-percent scurocaine. Instillations of neotutocaine were not employed, to avoid corneal desquamation and cloudiness. The bulbar conjunctiva was incised and dissected medially and superomedially, and a traction suture was placed in the medial rectus muscle. A transcleral diathermy puncture (bipolar, 50 ma.) was made in the 2-o'clock meridian. Ophthalmoscopic examination showed the area of chorioretinal coagulation to be peripheral and superior to the location of the cysticercus (fig. 17).

Second and third diathermy punctures

were made, the third one being close to the site of the parasite. At this point, the medial rectus was tenotomized. A fourth diathermy puncture was close to the upper border of the vesicle, and a fifth one, placed 1 mm. inferior to the previous one, confirmed the exact position of the lateral border of the parasite.

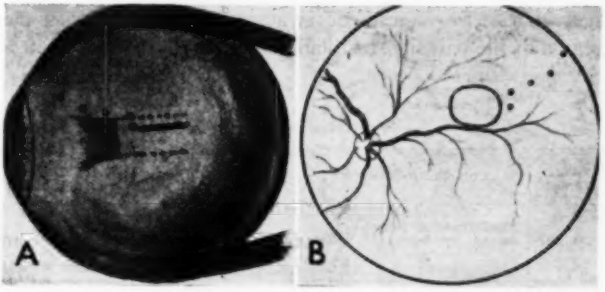

Fig. 17 (Lech Junior). (A) Diagram of operative procedure. (B) Showing localization of parasite by means of diathermy punctures.

A 6- to 7-mm. incision was made through the sclera behind the last diathermy puncture. Fixing the globe by grasping the insertion of the medial rectus, and having the assistant separate the scleral lips of the incision, the choroid was penetrated with the spatula. The cysticercus and a small amount of fluid were expelled when the intraocular pressure was increased by forced abduction of the globe. The medial rectus and conjunctiva were sutured. Ophthalmoscopic study revealed the absence of the parasite and very little choroidal disturbance. Atropine was instilled and a binocular dressing was applied. Laboratory examination confirmed the diagnosis of a cysticercus cellulosae measuring 3½ mm. in diameter. The sutures were removed after 7 days.

Result. On August 3, 1944, vision of the right eye was 0.7 improved to barely 1.0 with a − 1.0D. cyl. ax. 180°. The fundus (fig. 18) showed the diathermy punctures and a small scar at the site of the opening of the choroid. On February 3, 1945, a letter from Dr. R. Magalhães Gomes confirmed the excellent result, which we verified on reëxamination of the patient on February 8, 1945.

In the case described above, we did not try to localize the cysticercus in the first punctures, in order to avoid perforating the vesicle. The tenotomy was performed when we verified the need of a more posterior incision. The diathermic coagulations were of weak intensity and little penetration to prevent perforation of the retina or a greater trauma. This technique is applicable in all cases of subretinal or subhyaloid cysticercus in which the parasite is not situated at the posterior pole of the globe. An exact localization of the parasite permits incision at the precise site and it further permits expulsion of the vesicle without the introduction of forceps.

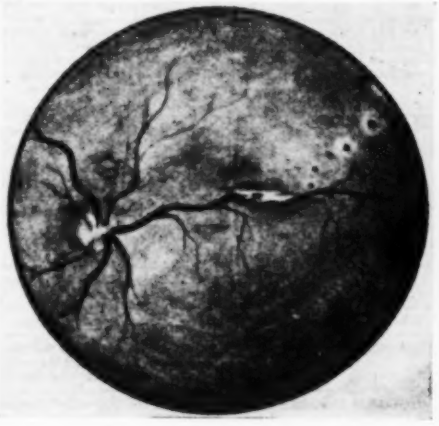

Fig. 18 (Lech Junior). Results obtained in the case shown in Figures 16 and 17. The fundus shows the diathermy punctures and a small scar at the site of the opening of the choroid.

2. SUBRETINAL, WITH SECONDARY DETACHMENT OF THE RETINA. The following general type of technique is employed. After asepsis and retrobulbar injection of 2- to 4-percent scurocaine, a subconjunctival injection of the same anesthetic is made in the region of the parasite. Instillations of a local anesthetic are to be avoided, so that ophthalmoscopic control can be carried out during the operation without cloudiness of the cornea.

After a conjunctival incision, a traction suture is placed at the limbus or in the nearest muscle. Lately, sutures have been

TABLE 2

OPERATED CASES OF SUBRETINAL CYSTICERCOSIS

Chart Number	Complications	Surgery	Vision		Course
			Before	After	
11.207	Exudates and detachment	Extraction with forceps	C.F. at 10 cm.	Nil Hemorrhage	Carrier of a cysticercus in each eye. Treatment given up with operation upon other eye. Epileptic attacks. ? cerebral cysticercosis
14.246	Iritis without detachment	Unsuccessful attempt	1.0	L.P.	Immediate hemorrhage. Atrophy of globe after 6 months. Complicated cataract. Enucleation.
16.570	Exudates without detachment	Spontaneous extrusion after incision	C.F. at 3 M.	0.2	Vision fell to C.F. at 2 M. 10 months later. Retinal detachment developed.
19.464	None	Extraction with forceps	C.F. at 2 M.	H.M.	Unknown.
22.975	None	Unsuccessful attempt	0.2	Nil	Immediate enucleation. Diagnosis confirmed at necropsy.
24.012	None	Spontaneous extrusion after incision	0.5	0.5	Good vision reported after 1½ years.
34.717	None	Extraction with forceps	C.F. at 1 M.	C.F. at 1 M.	Vision = C.F. at 2.5 M. 1 month later. Small hemorrhages and localized detachment.
35.671	Retinal detachment	Extraction with forceps	C.F. at 2 M.	C.F. at 3 M.	Vision = C.F. at 2 M. one year later. Slight exotropia.
43.824	Extensive detachment	Extraction with forceps	C.F. at 10 cm.	H.M.	Left hospital with quiet eye. Course unknown thereafter.
46.223	Retinal detachment	Extraction with forceps	C.F. at 0.5 M.	C.F. at 2 M.	Unknown.
55.425	Retinal detachment	Extraction with forceps	L.P.	L.P.	Vision Nil 15 years later. Quiet eye. Membranous cataract.
58.381	Synechias of iris	Unsuccessful attempt	0.4	H.M.	Eye quiet 9 years later. Exotropia. Complicated cataract. Hypotension.
60.273	Retinal detachment	Spontaneous extrusion after incision	0.5	0.5	Unknown.
61.260	Detachment. Suspected sarcoma of choroid	Spontaneous extrusion after incision	C.F. at 2 M.	C.F. at 2 M.	Unknown.
64.756	Exudates	Extraction with forceps	0.2	Nil	Detachment.
66.907	Without detached retina	Unsuccessful attempt	0.5	C.F. at 4 M.	Unknown.
86.307	Detached retina	Spontaneous extrusion after incision	C.F.	H.M.	Unknown.
104.509	Total detachment	Unsuccessful attempt	Nil	Nil	Unknown.
105.859	Small detachment	First operation not successful. Second led to extrusion after incision	0.2	0.4	Diathermic localization. Two months later, vision was 0.7 and there was no detachment.
108.168	Detached retina	Extraction with forceps	C.F. at 2 M.	C.F. at 3 M.	Extraction after parasite fell into vitreous. Vision = C.F. at 1 M. with extensive detachment 1½ years later.
124.032	Without retinal detachment	Spontaneous extrusion after incision	0.3	1.0	Diathermic localization. normal vision without detachment 7 months later. Case described in text.

TABLE 3

SURGERY OF CYSTICERCUS IN VITREOUS AND SUBHYALOID

Chart Number	Complications	Surgery	Vision		Course
			Before	After	
13.794	Detached retina	Extraction with forceps	0.1	H.M.	Unknown.
20.920	Exudates	Extraction with forceps	C.F. at 2 M.	H.M.	Retinal detachment.
24.605	Dense exudates	Extraction with forceps	H.M.	Nil	Hypotomy. Pseudoglioma.
27.304	Uveitis for 2 mos. Exudates	Two parasites extracted with forceps	0.2	C.F. at 2 M.	Complicated cataract.
44.274	Exudates	Extraction with forceps	H.M.	H.M.	Detached retina.
47.437	Exudates	Unsuccessful attempt	C.F. at 0.5 M.	H.M.	Detached retina
56.690	Detachment	Extraction with forceps	H.M.	H.M.	Unknown.
57.374	Exudates	Unsuccessful attempt	C.F. at 2 M.	H.M.	Unknown.
61.397	Exudates	Extraction with forceps	H.M.	H.M.	Unknown.
61.598	Complicated cataract. Previous operation	Extraction with forceps	Nil	Nil	Complete detachment.
67.374	Cyclitis	Extraction with forceps	C.F. at 2.5 M.	C.F. at 2 M.	Organized exudates in the vitreous.
73.725	Exudates	Extraction with forceps	C.F. at 20 cm.	H.M.	Detached retina.
77.858	Exudates	Extraction with forceps	C.F. at 3 M.	H.M.	Detached retina.
93.910	Cyclitis	Extraction with forceps	C.F. at 10 cm.	H.M.	Unknown.
95.082	Posterior synechias	Attempted successfully	H.M.	Nil	Detached retina. Quiet eye.
97.830	Exudate	Extracted with forceps	H.M.	H.M.	Unknown.
100.407	Extensive exudates	Extraction with forceps	Nil	Nil	Unknown.
100.444	Exudates. Detachment	Extraction with forceps	H.M.	L.P.	Detached retina. Quiet eye.
102.306	Detachment	Extraction with forceps	H.M.	H.M.	Unknown.
102.815	Detachment	Extraction with forceps	Nil	Nil	Unknown.
108.436	Diabetic exudates	Extraction with forceps	C.F. at 30 cm.	C.F. at 3.5 M.	Seclusion of pupil. Detachment later. Vision nil.
114.464	Exudates	Extraction with forceps	C.F. at 2 M.	C.F. at 3 M.	Later vision = C.F. at 2 M. Detached retina.
114.501	Exudates	Unsuccessful attempt	C.F. at 0.5 M.	Nil	Iridocyclitis and complicated cataract.
114.978	Localized exudates	Two parasites removed in two sessions	C.F. at 0.5 M.	L.P.	Quiet turbid vitreous. Outcome unknown.
115.502	None	Extraction with forceps	C.F. at 2.5 M.	0.8	Retinitis proliferans at site of incision.
116.018	Synechias of iris	Extraction with forceps	0.6	H.M.	Detached retina.
118.208	Exudates	Unsuccessful attempt	H.M.	H.M.	Unknown.
124.967	Detachment	Extraction with forceps	H.M.	H.M.	Quiet detachment.
127.629	Exudates. Detachment	Extraction with forceps	Nil	Nil	Detachment. Complicated cataract.
130.093	Exudates	Extraction with forceps	C.F. at 0.5 M.	H.M.	Unknown.
132.808	Exudates	Extraction with forceps	H.M.	C.F. at 1.5 M.	Unknown.
134.994	Cyclitis	Two parasites extracted in same operation.	0.4	0.2	Without detachment.
142.053	Exudates	Extraction with forceps	C.F. at 1 M.	H.M.	Unknown.
142.442	Exudates	Extraction with forceps	H.M.	H.M.	Unknown.
143.314	Exudates. Detachment	Extraction with forceps	C.F. at 0.5 M.	Nil	Cyclitis occlusion and seclusion of the pupil.
144.233	Exudates. Detachment	Extraction with forceps	C.F. at 2 M.	H.M.	Vitreous hemorrhage. Outcome unknown.
152.003	Exudates. Detachment	Unsuccessful attempt	C.F. at 2 M.	H.M.	Increase in detachment.
153.322	Exudates. Detachment	Extraction with forceps	0.3	H.M.	Vitreous hemorrhage. Detachment.
153.421	Exudates. Detachment	Unsuccessful attempt	C.F. at 10 cm.	H.M.	Vitreous hemorrhage. Detachment.

placed in the sclera at the sides of the proposed incision to aid in opening the incision during the introduction of forceps and extraction of the cysticercus. The incision of the sclerotic is made longitudinally between the sutures, layer by layer. The scleral cut must be long enough to allow opening the forceps in the interior of the globe. Curved smooth forceps are used to permit retrograde maneuvers with the globe in normal position for ophthalmoscopic control. The conjunctiva is sutured, whether the parasite is extracted or not, with or without previous diathermic cauterization of the scleral incision.

Extraction was attempted in 21 cases of subretinal cysticercus, with unsuccessful attempts in 6 patients, extraction with forceps in 8, and spontaneous delivery of the parasite after scleral incision in 7 patients. Thus, extraction was successful in about 70 percent of the cases.

e. Parasite in vitreous and subhyaloid. Extraction offers less difficulties, although spontaneous delivery cannot be expected after scleral incision. The parasite is easily seen and grasped when it is free in the vitreous, without interference of the retina.

OPERATIVE TECHNIQUE. This is identical with the preceding technique, except that

there is no need for special care in making the incision in the sclerotic. Since cysticercus in the vitreous is usually situated inferiorly, the patient should be in an almost sitting position.

Of all patients with cysticercus in the vitreous or in the subhyaloid region, 40 submitted to operation. Surgery was successful in 83 percent of the cases; 37 patients had a single cysticercus; 29 were removed in one session, with 7 failures. One was removed in two surgical sessions. Three patients had 2 parasites in one eye. In two of these, both parasites were removed in one operative procedure. The third had two cysticercuses, one removed in each of two sessions because of hypotony and turbid media.

From the above, it is apparent that extraction is possible in a high percentage of cases, given good technique and a little luck. From the figures below, one sees that this surgical procedure gave more successes than disappointments to the surgeons who undertook this operation.

Surgeon	Operations	Failures
A	17	4
B	17	3
C	12	1
D	10	4
E	4	2
F	2	0
Total	62	14

Thus, our results show 78 percent of successes in surgical removal of cysticercus within the posterior globe (excluding parasites in the anterior chamber, beneath the conjunctiva, and in subcutaneous sites). The outcomes reported by other observers using injections of corrosives or destruction of the parasites *in situ* by electrolysis or diathermy convince us that surgery is the preferred method of treatment.

Fig. 19 (Lech Junior). *Chart, No. 108.484.* Subretinal cysticercus. Three months after the first symptoms in (c) is seen a secondary detachment of the retina. Exudates in the vitreous prevent more precise image. The vessels of the retina covering the parasite are seen. The patient refused operation. Posterior disorganization of the globe led to enucleation, and the diagnosis was confirmed by pathologic examination.

Prognosis

Extraocular cysticercus offers a good prognosis. It produces no reactions worthy of note, nor damage to the eye or its function. The same can be said of cysticercus in the anterior chamber, for the parasite can be easily extracted with little trauma. On the contrary, when the cysticercus is retrolental, the prognosis is poor, not only for vision but also for the integrity of the globe.

In Table 4 are summarized the results in all of the cases not included under "treatment," and records our observations in operated cases of subconjunctival cysticercus, in patients with the parasite in the anterior chamber and in the region of the lacrimal sac beneath the skin, as well as in patients who refused operation and those who required enucleation for some reason or other and had the diagnosis confirmed by pathologic anatomy or by necropsy.

We note that 7 subconjunctival parasites

TABLE 4

RESULTS IN ALL CASES NOT INCLUDED IN TABLES 2 AND 3

Chart Number	Location	Complications	Vision at First Exam.	Course
A.L.	Vitreous	Exudates	C.F. at 1 M.	Unknown. Refused operation.
602	Vitreous	Cyclitis. Atrophy of the Globe	Nil	Enucleation.
2,336	Anterior Chamber	None	H.M.	Operation in S. Paulo. Course unknown.
3,105	Vitreous	Detachment	C.F. at 1 M.	Operation in S. Paulo. Larger detachment.
3,251	Vitreous	Iridocyclitis. Complicated cataract	Nil	Enucleation.
4,600	Subconjunctival	None		Operation. Uneventful course.
5,249	Subretinal	Exudates in vitreous	C.F. at 1 M.	Atrophy of globe 3 years later. Enculeation. Clinical diagnosis confirmed by necropsy.
6,636	Vitreous	Absolute glaucoma	Nil	Enucleation.
11,207	Subretinal	Iris synechias. Detachment	H.M.	Unknown. Refused operation.
12,932	Vitreous	Cyclitis. Atrophy of the globe	Nil	Enucleation.
13,800	Anterior Chamber	Cyclitis	H.M.	Preexisting corneal opacity. Operation. Vision =0.2.
15,118	Vitreous	Exudates. Detachment	H.M.	Unknown. Refused operation.
18,184	Subretinal	Detached retina	H.M.	Unknown. Refused operation.
19,790	Subretinal	Exudates with detachment	0.3	Unknown. Refused operation.
21,590	Vitreous	Exudates	0.1	Refused operation. Detached retina 1 year later, with Vision =H.M.
23,438	Subretinal	Exudates and detachment	H.M.	Unknown. Refused operation.
30,999	Subconjunctival	Hyperemia		Uneventful operation.
32,975	Subretinal	Exudates and detachment	H.M.	Unknown. Refused operation.
33,465	Orbit	None		Spontaneous expulsion.
40,000	Subretinal	Exudates. Macular localization	H.M.	Complicated cataract 9 years later.
45,283	Subconjunctival	None		Uneventful operation.
45,626	Subconjunctival	None		Uneventful operation.
49,531	Subconjunctival	None		Uneventful operation.
57,346	Vitreous	Atrophy of globe	Nil	Enucleation. Anatamopathologic diagnosis.
58,856	Subretinal	Purulent iridocyclitis	Nil	Unknown. Refused operation.
60,881	Subretinal	Seclusion	H.M.	Refused operation. Developed complicated cataract later.
66,089	Vitreous	Cyclitis. Pseudotumor	Nil	Enucleation.
67,345	Subconjunctival	None		Uneventful operation.
68,611	Subretinal	Purulent iridocyclitis	Nil	Enucleation. Diagnosis confirmed by pathologic studies.
69,027	Subretinal	Purulent iridocyclitis. Detachment	Nil	Refused operation. Developed complicated cataract later.
70,785	Subretinal	None		Uneventful operation.
71,787	Subhyaloid	Suspected tumor. Detachment	Nil	Enucleation. Pathologic diangosis.
71,980	Vitreous	Uveitis	Nil	Enucleation. Pathologic diagnosis.
72,920	Vitreous	Pseudotumor	Nil	Enucleation. Pathologic diagnosis.
76,385	Vitreous	Iris synechias. Detachment	Nil	Unknown. Refused operation.
77,916	Subretinal	Exudates and detachment	C.F. at 1.5 m.	Unknown. Refused operation.
81,619	Vitreous	Pseudotumor	Nil	Enucleation. Pathologic diagnosis.
85,097	Subretinal	Cyclitis. Iris synechias	L.P.	Refused operation. Complicated cataract and atrophy of globe later.
95,721	Vitreous	None	L.P.	Unknown. Refused operation.
105,775	Vitreous	Endophthalmitis	Nil	Enucleation. Pathologic diagnosis.
108,484	Subretinal	Exudates without detachment	C.F. at 30 cm.	Developed pseudotumor. Enucleation. Pathologic exam. confirmed cysticercus.
109,258	Vitreous	Cyclitis. Complicated cataract	Nil	Enucleated. Pathologic diagnosis.
118,747	Subretinal	Cyclitis. Complicated cataract	Nil	Enucleated. Pathologic diagnosis.
125,902	Vitreous	Exudates	Nil	Unknown. Refused operation.
134,163	Subcutaneous in region of lacrimal sac	None		Uneventful operation.
143,761	Vitreous	Exudates	C.F. at 20 cm.	Unknown. Refused operation.
145,757	Vitreous	Cyclitis. Detachment. Pseudotumor	Nil	Enucleation. Pathologic diagnosis.
147,178	Vitreous	Exudates and detachment	H.M.	Unknown. Refused operation.
151,709	Vitreous	Plastic choroiditis. Suspected tumor	Nil	Enucleated. Pathologic diagnosis.
153,528	Vitreous	Exudates and detachment	L.P.	Unknown. Refused operation.

were extracted uneventfully. Two were removed from the anterior chamber, one by Pereira Gomes in São Paulo and the other in our Institute. In the latter case, vision improved from hand movements to 0.2 notwithstanding preëxisting corneal opacities. One cysticercus was removed from the region of the lacrimal sac without sequela, and another, located in the orbit, was expelled spontaneously.

Fifteen patients rejected operation and the outcome was not known. In some patients who refused operation and were followed we found: increase in retinal detachment in 1, development of complicated cataract in 3, one atrophy of the globe followed by enucleation and confirmation of the clinical diagnosis. In one patient with a surgically inaccessible parasite in the macular region, a complicated cataract developed 9 years later.

In 18 cases, the diagnosis was made exclusively by immediate postoperative necropsy or by pathologic examination. Enucleation was indicated for different reasons: 7 because of suspicion of tumor; 4 for atrophy of the globe; 3 for iridocyclitis with complicated cataract; 1 for uveitis; 1 with endophthalmitis; 1 for absolute glaucoma; and 1 because of purulent iridocyclitis.

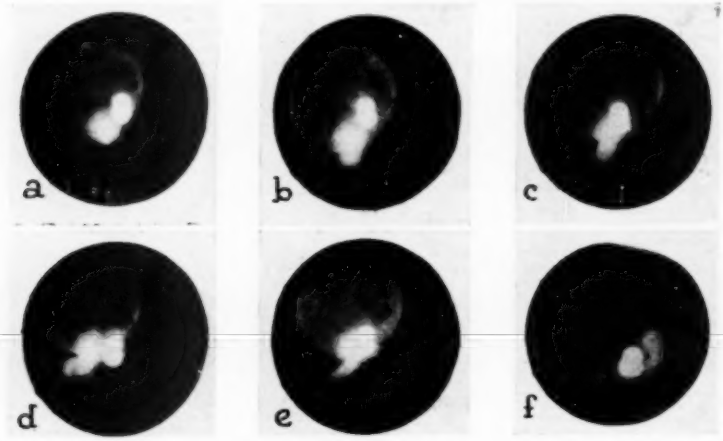

Fig. 20 (Lech Junior). *Chart No. 47.437.* Cysticercus free in the vitreous. The succession of photographs (a, b, c, d, e) shows the motility of the scolex. In (f), a photograph of the same case, it is possible to see two sucking cups on the head of the scolex.

As we see, the eyes containing a parasite suffer a wide variety of pathologic changes, showing destruction in about 80 percent of the cases in which the cysticercus was not extracted at an opportune time.

Comparison of the various tables convinces us that the involved eye stands a better chance if submitted to the earliest possible surgical therapy.

Prophylaxis

This is simple and has demonstrated its efficacy. At the end of the last century, cysticercosis was widespread in Germany according to Biancini. The prevention of teniasis, from which cysticercosis is derived, sufficed to reduce the frequency of this disease to a negligible amount of the German morbidity statistics. Prophylaxis consisted in inspection of meat, the use of efficient disposal of contaminated feces, and education in personal hygiene and eating, so as to prohibit ingestion of poorly cooked or inadequately smoked meats.

The public authorities should be more concerned with rural areas where human cysticercosis is more frequent. The rarity of the disease should not permit relaxation in efforts at prophylaxis, for this will also eliminate other organic affections, especially the very serious cases of cerebral cysticercosis.

From our statistics, the disease is not decreasing in São Paulo. During the past two years, we have observed 18 cases among about 20,000 patients. This proportion of 1:1,000 parallels the highest incidence recorded in northern Germany. Among a total of 150,000 patients examined in 30 years, we found 111 cases of ocular cysticercus, although it is likely that other cases were missed or undiagnosed.

Pathology

The histologic diagnosis of cysticercus is not difficult when the parasite can be observed in microscopic sections, but good slides are not always easy to obtain. Certain features of the inflammatory capsule suggest the presence of cysticercus which should be sought for in serial sections. Sometimes the complete parasite can be demonstrated, or else certain of its parts when inflammatory and degenerative changes have caused disorganization. The cysticercus is characterized by (a) the scolex, with its suckers and crown of hooks, (b) the gland-shaped folds of the neck, and (c) the membrane of its vesicle. When degenerative processes involve the parasite it may not always be possible to identify these structures. The diagnosis, then, may be confirmed by encountering even a single hook, which as a rule lies in a necrotic mass.

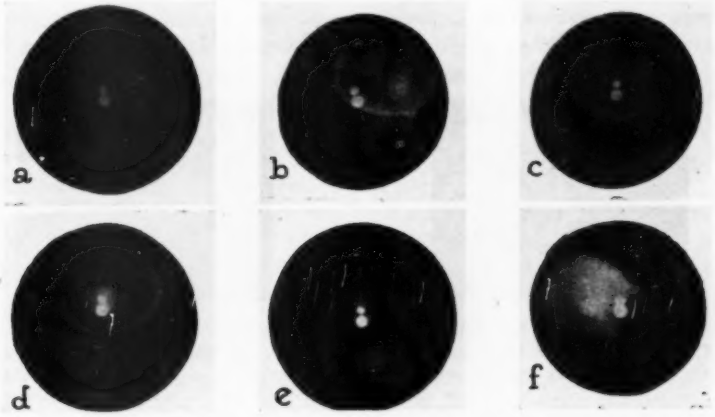

Fig. 21 (Lech Junior). *Chart No. 102.306.* Subhyaloid cysticercus. This series of photographs shows the undulatory movements of the wall of the vesicle and the slight motility of the partially evaginated scolex. In (f) is seen subretinal parapapillary fibrous tissue at the original site of the parasite whence it migrated into the subhyaloid space.

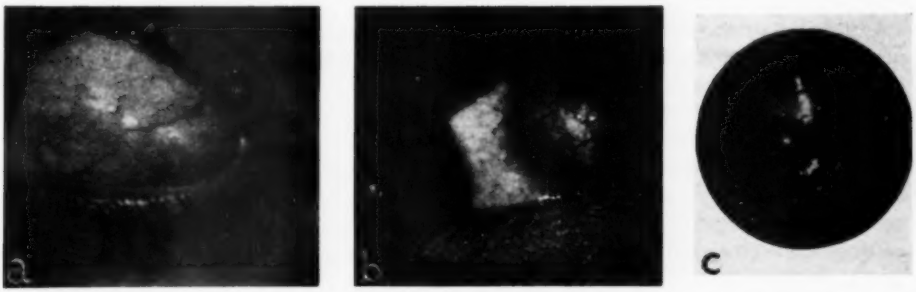

Fig. 22 (Lech (Junior). Subconjunctival cysticercus is revealed in three photographs. In (b) we note the central condensation which differentiates cysticercus from lymphatic cyst, as well as the hyperemia which is the only reaction provoked by the parasite.

The reactive capsule is made up of three more or less distinct layers, consisting from within outward of the following: (a) a zone

of purulent exudate with a more or less wide band of coagulation necrosis; (b) a zone of histiocytes, young fibroblasts, and an occasional rare giant cell of the Langhans type: and finally (c) a wider zone of sclerosis with a diffuse and intense mononuclear (lymphocytes and plasmocytes) exudate, with or without eosinophils.

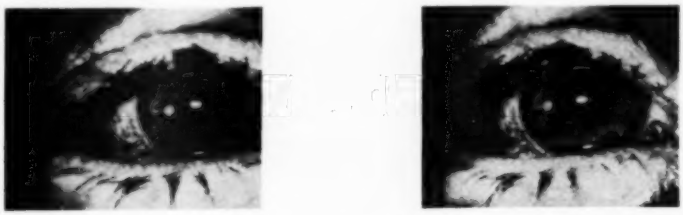

Fig. 23 (Lech Junior). *Chart No. 108.436.* Stereoscopic photographs of the scolex moving in the anterior chamber. The patient was a diabetic married woman with a cysticercus in each eye. The parasite in the right eye was extracted from the vitreous. Diathermic cauterization of the subhyaloid cysticercus in the left eye by a colleague failed to destroy the parasite, and the eye became inflamed. The exudates and reaction prevented immediate surgical extraction. While under treatment to quiet the eye, the patient complained of severe pain in the eye and headache. Examination showed the parasite in the anterior chamber with its suckers attached to the posterior cornea. By pseudopodlike movements of the suckers, the parasite moved toward the opposite side. Extraction was performed with forceps through a small corneal incision. When the caudal part of the scolex was grasped, it tore, leaving its head attached to Descemet's membrane. It was necessary to grasp the head of the scolex directly to effect its removal.

In this last zone we can find the remains of ocular structures (retina, sclerotic) showing various regressive changes (detachment, edema, hemorrhages, deposits of cholesterin, and even bone formation in some of the oldest cases). We have observed more than once the development, in this inflammatory area, of an abscess cavity in which serial sections made posteriorly revealed the parasite.

Description

Ocular cysticercosis is a rare disease, and its identification is difficult for those who have not studied it in specialized clinics and who have not paid attention to this subject in the literature. I am convinced that this diagnosis has been given many different and extravagant labels by observers who were ignorant of the existence of this nosologic entity.

Penido Burnier recognized his first case by his knowledge of the literature and of Sichel's illustrations. Cockburn evolved his diagnosis through his knowledge of the evolutionary cycle of tenia infestation.

Illustrations help to engrave in our memories the multiple aspects of this ocular parasite. Therefore, we have illustrated this paper freely. Many opportunities for obtaining pictures were lost because of the lack of photographic material during the last war.

Summary

This work represents the experiences of the ophthalmologists and pathologist of the Instituto Penido Burnier with 111 patients bearing 116 ocular cysticerci. The parasites were situated as follows: 51 in the vitreous; 10, subhyaloid; 44, subretinal; 2 in the anterior chamber; 7, subconjunctival; 1 in the orbit; and 1, subcutaneous in the region of the lacrimal sac. The youngest patient was aged 2½ years, the oldest was 66 years of age. The greatest frequency was found before the age of 40 years (96 cases). There was a slight predominance in women (64 female patients, 47 males). In 56 cases, parasites were in the right eye; in 50, in the left; 2 were binocular; 2 were double in a right eye; 1 was double in the left eye. In 101

eyes the diagnosis was made clinically, and in 15, it was made after necropsy (of these, 12 were examined pathologically).

History. Schott and Sömmering (in Frankfort, in 1829) independently observed the same cysticercus in an anterior chamber. The former extracted the parasite. Siebold (1838) published a report of the subconjunctival cysticercus observed by Baum. Two years after the discovery of the ophthalmoscope, Coccius saw a cyst in the vitreous resembling a cysticercus. Only in 1854 were the first indisputable observations of cysticercus in the vitreous and under the retina made by von Graefe, who, by 1866, had seen more than 80 cases among 80,000 patients.

Etiology and Pathogenesis. Ocular cysticercosis obeys the same laws of general infestation as cysticercus cellulosae, the larva of tenia solium. Heteroinfection is more common than autoinfestation. The parasite is encountered in all the tissues of the eye except the lens. When intraocular, cysticercus provokes an exudative inflammatory reaction (exudates, iritis, uveitis, purulent iridocyclitis, and even panophthalmitis). Among the complications are: detachment of the retina, synechias of the iris, complicated cataract, and atrophy of the globe.

Diagnosis. Ocular cysticercosis is a rare disease (116 in 54,000 patients, or 1:1,383). When intraocular, the first symptom is reduction in vision. During the first months of infestation, if the media are clear, the cysticercus can be positively identified: by its bluish-white spherical vesicle with peripheral iridescent reflexes and slight undulatory movements at times; and by its scolex which, when evaginated, reveals the sucking cups and, when invaginated, appears as a denser white spot in the center of the vesicle.

When the media are more turbid, diagnosis is more difficult. Penido Burnier has taught us that we must be alert to the possibility of cysticercosis. It is not enough to see a white spot through the exudates of exudative choroiditis, or to note a detachment of the retina which is a complication of the parasitosis. The inferior vitreous, where the parasite is more often encountered, must be explored. We have to pay greater attention when the complement fixation reaction in the blood is positive, for it is positive in 73.2 percent of cases—a valuable aid in diagnosis. The subconjunctival cysticercus resembles the lymphatic cyst from which it can be distinguished by the denser white spot in the center.

Treatment. Medical therapy and destruction of the parasite by caustics, diathermy, and electrolysis are ineffective. The organism must be extracted by the transcleral route when it is behind the lens. The parasite, living or dead, is destructive to the eye, and must be removed to preserve the globe. In 40 attempts, 34 extractions from the vitreous or from the subhyaloid area were successful. In 21 trials, 15 parasites were removed from beneath the retina, 7 of these being spontaneous extrusions after incision of the sclera and choroid. Extraction may preserve vision in the early cases of subretinal cysticercus by using diathermic localization under ophthalmoscopic control.

Prognosis. Extraocular cysticercus is benign, but the intraocular disease leads to blindness with rare exceptions.

Prophylaxis. Control and inspection of meat, and personal and dietary hygiene are essential, especially in rural areas, where almost all of the carriers of cysticercus live.

Pathology. Sometimes the diagnosis is difficult especially when careful search reveals only a single relic of the parasite such as its hooks or the typical histologic reaction.

Description. A knowledge of this is of great value, particularly for those who are not familiar with the diagnosis. Many must have seen the parasite without recognizing it. Where tenia solium is found, there must be a certain proportion of ocular cysticercus.

Instituto Penido Burnier.

DISCUSSION

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I consider the paper of Dr. Lech Junior of importance because it gives new data about the frequency of cysticercosis in Brazil and also because of the successful results obtained with surgical treatment in the preservation of the eye and the improvement of visual acuity. Dr. P. Burnier and Dr. Sales in their paper, in 1935, state that the frequency of cysticercosis in Brazil was about 62 cases among 70,000 patients of eye diseases.

Dr. Lech Junior asserts that in the Instituto Penido Burnier the proportion in later years has been 1 case in about 1,383 patients. In these new statistics he observed 111 cases of which 51 were in the vitreous, 10 subhyaloid, and 44 subretinal. He also observed 2 in the anterior chamber and 9 under the conjunctiva, the skin, and in the orbit.

During the first years of my practice in Mexico City, I had the opportunity of seeing 3 or 4 cases of intraocular cysticercosis, while during my whole practice in New York I have not been able to see a single case.

The appearance of the vesicle of cysticercus and its movements in the vitreous are one of the most striking and beautiful views that can be observed with the ophthalmoscope. The spheric vesicle has a bluish iridescent coloration, contrasting with the white aspect of the body and head of the parasite, the latter especially visible when it has moved outside of the vesicle.

The literature about this disease in Mexico is abundant. Many observers—Ramos, 1887; Lopez, 1903; Chavez, Montaño, 1902; Silva, 1928, and lately Puig Solanes, 1946, have minutely described the clinical symptoms of cysticercosis and emphasized the importance of an early operation to remove the parasite.

Chavez found in Mexico 1 case of cysticercosis in about 4,000 patients of eye diseases, a proportion lower than that of Dr. Lech Junior.

Montaño, as early as 1902, used electrolysis for the destruction of the parasite in the vitreous. Other surgeons have used caustics, diathermy, and radium. The consensus of opinion, however, is that the parasite should be removed from the eye; for even when destroyed and dead it is able to elicit great inflammatory reaction.

Dr. Lech Junior's statistics of 34 successful extractions from the vitreous in 40 cases, or 85 percent, are impressive; as the average of successful operations mentioned by other authors is only 60 to 70 percent of the cases (Duke-Elder). In 21 subretinal cases he was able to remove the parasite 15 times. I believe the method he describes, of making accurate localization of the parasite with nonperforating diathermic cauterizations, nearer and nearer to the vesicle, until its exact place has been accurately found by ophthalmoscopic examination, may have contributed materially to the success of his operations.

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APPARENT ROTATION OF A FIXED TARGET ASSOCIATED WITH LINEAR ACCELERATION IN FLIGHT*

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INTRODUCTION

This study is one of a series of investigations which have been designed to establish factors that are important in proper orientation during flight. The original stimulus for these studies came as a result of a series of airplane accidents that occurred under peculiar circumstances. These accidents were characterized by the fact that the pilot became confused or disoriented at the time of the crash. The pilots reported difficulties which fell into several categories: (1) States of confusion, (2) disturbances in equilibrium, (3) undue fascination on objects, and (4) various types of visual illusions.

Orientation in space during flight has been found to be subject to a number of illusions even under normal conditions in the daytime.[12] However, when visual cues are reduced as in night flying, additional illusory effects appear.[1, 4-9] One of these is known as autokinesis or the autokinetic illusion.[4] This refers to certain illusory perceptions of movement of a fixed object in the visual field when other visual references are meager or lacking. Autokinesis is most prominent in the case of an isolated light in the dark when it is experienced universally by normal persons. It has been found to occur not only in the laboratory but also in flight and can be considered to be a factor contributing to disorientation in pilots.

A still more important factor in causing visual disorientation during flight is the effect of acceleration on the nonacoustic labyrinth. Here, it is necessary to distinguish between the effect of angular acceleration on the semicircular canals and the effect of linear or radial acceleration on the otolith organs. Previous studies both in the laboratory and in the air have served to define the chief characteristics of the associated illusory effects.[1, 3, 6-11]

If a person is subjected to angular acceleration in the dark, while viewing an object which rotates with him, this object will appear to move in a characteristic manner which we have termed the oculogyral illusion.[6, 7] This apparent movement is due, in large part at least, to ocular nystagmus which is produced reflexly following stimulation of the semicircular canals. The eye movements produce a tracking of the image across the retina which, during the slow phase of the nystagmus, is perceived as movement of the object rather than of the eyes. This effect is observed following angular accelerations of as small as 0.2 degree per second per second,[10] but the illusion is displayed in the most striking fashion when the observer is subjected to strong angular acceleration while viewing a moving object.

If, for example, the real movement of the object is clockwise and the apparent motion counterclockwise, a paradoxical situation is created in which the observer must keep turning his head to the right in order to keep in view an object which appears to be rushing in the opposite direction.[7] The chief

* This research was carried out at the School of Aviation Medicine and Research, Naval Air Training Bases, Pensacola, Florida. The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the view of the Navy Department or the Naval Service at large.

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characteristics of the oculogyral illusion in the horizontal plane are: (a) the direction of motion is related to the direction of acceleration; (b) the lag between the onset of acceleration and the maximum illusion of motion is short; (c) objects appear to move rapidly but are displaced relatively little from their original position; and (d) following a strong stimulus there are prolonged after effects in which the apparent motion may reverse itself one or more times.[6, 7]

The effects of radial acceleration in causing visual disorientation differ markedly from those of angular acceleration and, although the exact mechanisms mediating the effects are unknown, they are caused in part at least by stimulation of the otolith organs.

If, for example, a person is rotated at constant speed on a human centrifuge, the perception of the vertical, in the absence of visual cues, will tend to coincide with the direction of the resultant of the centrifugal force and the force of gravity.[5] If now the observer regards an object in the dark which does not provide adequate cues for orientation to the earth, this object will be projected in space in accordance with the apparent vertical direction.

Thus, when a subject faces toward or away from the line of resultant force, an object on the horizon will appear to be, respectively, above or below it. If the subject is at right angles to the force, the object will appear to rotate clockwise if the direction of force is from the left, and counterclockwise if the force is from the right.

The characteristics of this phenomenon, which has been termed the oculogravic illusion, are as follows: (a) the direction of the displacements bears a constant relation to the resultant force; (b) under constant acceleration the object may not appear to move but simply to be displaced in space; (c) a considerable lag is observed between the onset of the stimulus and the maximum illusory effect; and (d) there are no after effects following cessation of the stimulus.[1, 8, 9]

It has been pointed out elsewhere[2] that a clear distinction must be made between three types of acceleration which affect a pilot's orientation during flight; namely, angular acceleration, radial acceleration, and linear acceleration.

Angular acceleration is a change in the velocity of rotation and is the adequate stimulus to the semicircular canals. Reflex connections to the extraocular muscles produce ocular nystagmus and resultant illusory effects.[6, 7]

Radial acceleration or centrifugal force results when the pilot rotates about an axis at some distance from his body, for example in a normal turn. This accelerative force is a stimulus to the otolith organs and causes generalized changes in bodily pressure. It is invariably associated with rotation but not necessarily with angular acceleration. This force results in the apparent displacement of stationary objects in the dark.[1, 8, 9]

Linear acceleration is a change in velocity from point to point without a change in direction. Linear acceleration and deceleration acting in the horizontal plane as the aircraft changes velocity combine as a vector with the force of gravity to produce a resultant force which is greater in magnitude and acts in a different direction from the force of gravity. The change in magnitude, and direction of this resultant force and its effect on visual perception are the primary factors with which this report is concerned.

Apparatus and Procedure

An experimental procedure which was used in studies of the effects of angular and radial acceleration on visual orientation was adapted for use in this study.[9] The subjects observed a collimated "star" while they were seated in the rear cockpit of an SNJ-6 aircraft during flight. The star consisted of a central luminous point with six symmetrically placed radiating lines and was observed in complete darkness which was made possible by a light-proof goggle mounting attached to the instrument and a covering for the head. Head movements were minimized by a biting

board. Trials were run while the subject faced 85° to the left of the forward motion of the aircraft. The three subjects* were experienced observers, having made many similar observations both in flight and in the laboratory.

Each observer gave a running account of the illusory motion of the star by using a throat microphone which was connected to an airborne wire recorder. Hence, the subjects' verbal reports were automatically recorded for future study in the laboratory after the flight. As each verbal report was given the subject simultaneously pressed a switch which marked the accelerometer record. This made is possible to relate each report of the movement of the star to the changes in the acceleration of the aircraft. All measures of temporal relations were therefore made directly on the accelerometer records.

In order to obtain a measure of the accelerative forces in operation during the observations, an accelerometer which measures the force of acceleration was set on shock mounts in the luggage compartment of the aircraft just back of the observer.† The instrument consists of three independent accelerometer units, one for each of the major planes of the aircraft. The individual accelerometer mechanisms consist of a weight supported between two metallic bellows and guided in the direction of its action by means of a central rod passing through the bellows and through the weight. Radial ball bearings mounted on the weight reduce the friction between the weight and the central rod to a negligible value.

Air damping is used. When the weight moves along the rod, one of the bellows is compressed while the other is extended and air is forced from one to the other through a hole in the center of the supporting rod. The amount of damping is adjustable. Motion of the weight is transmitted to a stylus by means of a simple linkage system.

A record of the accelerative forces is obtained on a special aluminum-backed paper by means of a small electrical charge passing between the stylus and the recording drum. Two solenoid markers are also available to be used as signal devices. The range of measurable accelerations is 2G. in planes other than the vertical where it is +6 to −3G.‡

Measurements at any point on the record are read directly by placing a calibrated celluloid mat over the chart. This device made it possible to measure the force of acceleration in all of the three major axes of motion of the aircraft. When these records were taken simultaneously with a subject's reports of his perceptual experiences, it was possible to correlate the accelerative stimuli with the illusory reports of motion and displacement of the target.

Linear acceleration and deceleration occur in flight as a result of the increase and decrease in the power used or the raising and lowering of the flaps which have a braking effect on the aircraft. In this experiment all of the observations were made at altitudes ranging from 4,000 to 7,000 feet.

Accelerative forces of different magnitudes were produced by setting the initial air speed at 90 m.p.h. and using various combinations of flap positions and increase in throttle setting to raise the air speed. For the maximum accelerative force full throttle was applied and the flaps were raised simultaneously. Decelerative forces were produced by reversing this procedure. Thus, accelerative forces having maximum values ranging from 0.03 to 0.20G. and decelerative forces having maximum values from 0.04 to 0.44G. were produced.

A typical series of experimental trials

* The subjects were the authors and Richard C. Snyder, PhM/1c, U.S.N.

† This instrument is a special modification of the Hathaway Type AR-1 Flight Analyzer and was designed to measure accelerative forces within the range known to affect visual perception. It was designed and made by the Hathaway Instrument Company, Denver, Colorado.

‡ In this paper G. will be used to refer to the force of acceleration measured in terms of the force of gravity as unity.

was conducted as follows: The pilot would select the most desirable altitude and level off the plane at a prearranged speed. The subject prepared the equipment and set the recording devices in operation. The subject then said, "Trial one" and simultaneously pressed a switch to mark both the wire recorder and the accelerometer record. The pilot waited from 5 to 15 seconds and applied the accelerative or decelerative force by appropriate manipulation of throttle and flaps.

Throughout the trial the observer gave a running account of any motion or displacement of the star and for each report simultaneously pressed a switch and thus marked the accelerometer record. The pilot reported when the plane had been flying without change in speed for 20 seconds, and the observer marked the record indicating the end of the trial.

This sequence was followed for 12 to 24 trials for each flight alternating accelerative and decelerative stimuli. The magnitude of the stimuli was prearranged to be in random order and was unknown to the subject. Rest periods occurred after each series of six observations.

The principal effect reported by the subjects was rotation of the "star" about the central point in the plane of the radiating lines. They reported the illusory rotation of the star indicating whether it was clockwise or counterclockwise and the onset and offset of rotation. They also estimated the extent of rotation and displacement in degrees from the "true" position in which one set of radiating lines was horizontal.

The data from the two recording devices were combined in the laboratory. The data from the wire recordings were transcribed onto the accelerometer records. All determinations of the stimulus-response relationships were then made by measurements directly on the accelerometer record, the temporal measurements being made to the nearest second.

The magnitude of the linear accelerations involved was determined by the use of an "interpretation mask" supplied with the accelerometer. The calibration of this "mask" was checked by producing known forces on a human centrifuge and was found to be accurate within the error of measurement of the forces on the record.

The description of the linear accelerative forces produced by the aircraft presented certain unique problems because the accelerative force was far from constant throughout any trial. In the typical psychophysical experiment, stimuli of constant intensity are presented to the observers for a prearranged period of time. These controls were impossible in this experiment because the forces were a function of the accelerative or decelerative characterstics of the aircraft. Therefore, the accelerative and decelerative forces used were constant for only a brief interval of time.

The force in each case has been described in terms of three variables involved: (1) the duration of the force, (2) the maximum acceleration or deceleration produced during the trial, and (3) the time required to reach this maximum force. It was not possible to take completely into account the significance of the variations of changing accelerations during the interval the stimulus occurred.

The distribution of maximum decelerative forces, the mean time to reach this force, and the mean time the force was acting on the subject are shown in Table 1. There is no regular or significant difference between the two temporal variables for the different maximum forces reached. The trend was for the force to increase rapidly to its maximum value within approximately 5 seconds; this maximum force remained only for a short period (2 to 3 seconds) after which there was a slow reduction to zero. The total duration of the force averaged approximately 28 seconds. The typical pattern was a rapid increase to a maximum followed by a gradual reduction over a prolonged period. Correlations among the three measured stimulus variables were negligible.

The accelerometer records were also

TABLE 1

THE TABLE SHOWS THE DISTRIBUTION OF THE MAXIMUM ACCELERATIVE AND DECELERATIVE FORCES ATTAINED IN THE VARIOUS TRIALS, THE MEAN TIME REQUIRED TO REACH THIS MAXIMUM FORCE, AND THE MEAN TOTAL DURATION OF THE FORCE FOR THE THREE SUBJECTS

Maximum Decel. Force in G.	N	Mn Time to Max. G. (In. Sec.)	Mn Duration of G. (In Sec.)	Maximum Accel. Force in G.	N	Mn Time To Max. G. (In Sec.)	Mn Duration of G. (In Sec.)
.04–.06	9	7.1	23.1	.02–.03	8	7.3	27.4
.07–.09	22	8.6	32.5	.04–.05	21	5.8	28.9
.10–.12	10	4.8	25.9	.06–.07	17	5.2	30.9
.13–.15	11	4.0	25.9	.08–.09	12	4.7	28.8
.16–.18	14	4.3	28.9	.10–.11	11	2.6	30.6
.19–.21	20	5.5	25.6	.12–.13	4	5.5	25.5
.22–.24	6	6.7	26.7	.14–.15	11	5.4	25.4
.25–.27	7	5.7	26.7	.16–.17	14	5.2	28.9
.28–.30	10	5.5	22.6	.18–.19	8	5.9	33.4
.31–.33	5	4.2	23.8	.20–.21	1	8.0	45.0
.34–.36	1	6.0	28.0				
.37–.39	3	5.5	31.0				
.40–.42	2	3.5	26.5				
.43–.45	1	5.5	31.0				
Total	121	5.8	27.2		107	5.1	29.6
Stand. Dev.	—	3.2	6.7		—	2.4	7.8

studied to determine whether there were forces evident in the other two major planes of the aircraft. Lateral forces (slipping and skidding) were not evident on any of the records. The sensitivity of the accelerometer was 0.02G. so any lateral force was less than this value. Some vibration was evident but this was constant throughout all trials and appeared in all three planes.

The accelerometer which recorded the vertical component of force registered accelerations and decelerations of measurable amounts (that is, greater than 0.10G.) during some of the trials. During accelerations greater than 0.13G. and during decelerations greater than 0.21G. the average positive component was less than 0.10G.

In other words the aircraft lost altitude for a few seconds during acceleration and gained altitude for a few seconds during deceleration due to the operation of the flaps. This component of force was greater during deceleration than during acceleration, but in each case the average duration of this force was less than the time required for acceleration or deceleration as recorded by the fore and aft component to attain its maximum value.

The effect of this change in altitude was either to increase or decrease the vertical component of the force for a short period. This modified the pattern of increase of the resultant force acting on the body without affecting the maximum force reached or the duration of the change in force.

The net result of the linear accelerative forces was to change both the magnitude and direction of the resultant force acting on the body. During normal straight and level flight, the force of gravity was acting on the body in a vertical plane. During acceleration the added forces produced changes in the magnitude of the resultant force varying from 1.0004G. to 1.0218G. and changes in direction from 1.7° to 11.9°. During deceleration the resultant force varied between 1.0008G. and 1.0925G. while its change in direction varied between 2.3° at lower intensities to 23.7° at higher intensities.

Angular accelerations were kept subthreshold during these maneuvers by appropriate operation of the aircraft. The pilot kept the wings level, kept on a constant heading, and kept the nose of the plane on the horizon. The loss of altitude during

certain trials may have produced small angular accelerations about the horizontal axis of the plane. These stimuli appear to have been subthreshold because the pattern of response was the same even during the deceleration runs where the change in altitude was greatest.

Experimental results

Illusory effects during deceleration. Although in this experiment the forces were at or near the threshold and of short duration, clockwise rotary motion and displacement occurred at all levels of stimulus intensity used. The rotation observed in these trials involved a rotary displacement about the central point of the star to a new position. This was usually accompanied by motion but occasionally the displacement would appear suddenly without any apparent motion. As the accelerative force decreased, the star rotated slowly back to its original position.

The percent occurrence of rotary motion and displacement of the target during deceleration is to be found in Table 2. On several trials the subjects reported rotary motion without accompanying rotary displacement. When these data were plotted typical S-curves resulted, the motion curve being displaced slightly to the lower stimulus values. The group limen for motion determined by linear interpolation was found to be 0.067G, while the group limen for displacement was found to be 0.078G. Motion was reported in all trials above 0.22G, while both motion and displacement were reported in all trials above 0.30G.

The mean duration of the illusory rotation and the mean maximum rotary displacements showed a progressive increase with increasing force of deceleration (table 2). The average displacement reported for decelerative forces from 0.03 to 0.06G. was 1.4° and this increased to 10.0° for decelerations from 0.43 to 0.46G. The maximum report of rotation was 15°. There were five such reports by two subjects.

The average duration of the rotary effec varied from 9.2 seconds to 22.0 seconds; its duration was on the average less than half the total duration of the stimulus (tables 1 and 2). On 16 trials, however, the three subjects reported that the illusory rotation lasted beyond the point where the decelerative force had been reduced to zero.

This suggests the possibility of a positive after-effect, although it may have been a result of a delay in reporting the termination of the effect which presented a difficult subjective judgment.

Illusory effects during acceleration. Counterclockwise rotation and accompanying rotary displacement of the fixation object occurred during acceleration (table 3). All of the stimulus levels used were above threshold since both rotary motion and dis-

TABLE 2

Percent occurrence of illusory effects, maximum displacements, and temporal relations for various maximum decelerative forces

Maximum Decel. Force in G.	.03–.06	.07–.10	.11–.14	.15–.18	.19–.22	.23–.26	.27–.30	.31–.34	.35–.38	.39–.42	.43–.46
N	9	25	14	18	23	7	13	5	4	2	1
% of Motion Reports	33	64	71	72	96	100	100	100	100	100	100
% Displacement Reports	22	56	71	67	87	100	92	100	100	100	100
Mean Max. Clockwise Displacement in Degrees	1.4	2.4	5.1	3.6	7.5	8.5	7.4	5.7	9.0	10.0	10.0
Mean Duration of Motion in Sec.	9.2	12.8	15.2	13.9	16.8	21.3	16.6	14.0	15.8	22.0	22.0
Lag to First Report in Sec.	5.7	6.1	5.5	4.8	5.0	3.9	4.3	6.2	6.3	4.5	5.0

TABLE 3

THIS TABLE SHOWS THE EXTENT, LAG IN TIME TO FIRST REPORT, AND DURATION OF ILLUSORY ROTATION OF THE STAR FOR VARIOUS MAXIMUM ACCELERATIVE FORCES

Maximum Accel. Force in G.	.02–.03	.04–.05	.06–.07	.08–.09	.10–.11	.12–.13	.14–.15	.16–.17	.18–.19	.20–.21
N	8	20	18	12	11	4	11	14	8	1
Mean Counter-clockwise Rotation in Degrees	6.0	10.0	8.8	10.0	10.1	9.8	11.0	10.2	9.8	10.0
Mean Duration in Sec.	30.6	29.4	29.9	27.2	26.8	25.8	29.9	25.9	27.6	25.0
Lag to First Report in Sec.	5.6	5.4	5.2	4.6	4.2	4.8	5.0	4.4	3.9	6.0

placement were reported during 105 of 107 trials for the three subjects. Within the range of accelerative forces used, there was very little relation between the degree of force and the amount of reported rotary displacement.

Although the mean value in the lowest group of forces was notably less than the mean scores for greater forces, this difference was not significant at the 10-percent level by the chi-square test, although it approached this level. The maximum rotation was 15° reported by two subjects during 30 trials distributed throughout the complete range of accelerative forces. There was no uniform change in the duration of the rotation for the various stimulus intensities, but the time lag from the beginning of the accelerative force to the first report of motion decreased as the accelerative force increased.

Illusory effects with the subject facing forward. Some additional trials were also run with the subjects facing forward rather than to the side. On the basis of the forces involved the star could be expected to rise during acceleration and fall during deceleration.[1, 2, 8, 9] However, these displacements did not occur with the expected regularity in the case of all subjects.

This may be attributed to two factors: (1) The short duration of the strong part of the accelerative force, and (2) the judgments of the degree of displacement are much more difficult to make than the judgments of the rotation of a horizontal line; this is particularly true with regard to judgments of the initial reference level. An additional investigation will be made of this problem in a future study.

DISCUSSION

The data reported here show clearly defined changes in the apparent position of an isolated target in the dark when the subjects were exposed to linear acceleration or deceleration during flight.

The characteristics of the illusory effects were similar to those found for radial acceleration on a human centrifuge in the following ways:[8] (a) the direction of the apparent rotation bore a constant relation to the direction of the linear acceleration, and the illusory effect was uniformly shorter in duration than the stimulus; (b) there was a lag in time of from 4 to 6 seconds between the onset of the stimulus and the first report of rotation; (c) the displacement of the target to a new position usually occurred with accompanying motion but sometimes appeared suddenly with little or no motion; (d) after effects were not regularly observed.

In general, the orientation of the subject with respect to the isolated visual target was in accordance with the resultant of the force of the linear acceleration and the force of gravity acting on the subject; however, the extent of the rotation of the target was less than the change in the direction of the resultant force.

These data lend support to the hypothesis

that the disorientation of the subject is a result of the stimulation of the otolith organ, although sensations of increased bodily pressure and change in bodily position may contribute to the total perception.

The results of this experiment show that accelerations and decelerations such as may be encountered in the normal operation of an aircraft produce the illusion of rotation of an isolated target in the dark if the subject is facing toward the side.

These illusory effects may result from linear acceleration as reported here, from radial acceleration acting in the same direction as the forces in this experiment,[8] from angular accelerations which affect the vertical semicircular canals,[3] or from combinations of these factors. In normal flight all three commonly occur simultaneously and to isolate them requires particular care in the operation of the aircraft.

When the rotary displacement of the target is judged as real, or if the rotation is referred to the subject himself, the result will be disorientation on the part of the pilot. The practical significance of such effects is emphasized by the fact that pilots flying at night have reported rotations of the visual field which subsequently proved to be illusory.[12, 13]

Reports of illusory motion and displacement were made at all stimulus levels used for both acceleration and deceleration, but there was a substantial difference in the threshold levels of the two forces. The explanation of this difference is not immediately apparent from an analysis of the subjects' reports or the nature of the accelerative and decelerative forces. The reports of rotation were basically the same in the two situations and the general patterns of the records of the forces were closely similar both on the basis of inspection and a comparison of the various parts of the curve of force.

Summary

The purpose of this study was to determine the effects of linear acceleration and deceleration on the visual perception of a target in the dark. Three subjects observed a collimated "star" in the dark while the pilot of an SNJ-6 aircraft executed various degrees of linear acceleration. The subjects gave a running account of the behavior of the "star" using a throat microphone connected to a wire recorder.

The forces produced represented the range of accelerations and decelerations occuring in the normal operation of the aircraft. The forces were measured by a three component accelerometer which showed that accelerative and decelerative forces built up to a maximum in approximately 5.5 seconds and within 2 to 3 seconds began to drop off slowly to zero.

The net result of these accelerations and decelerations was to change both the magnitude and the direction of the resultant force acting on the subject. The magnitude of the maximum resultant forces varied between 1.0004G. and 1.0925G., and its change in direction varied between 1.7° and 23.7°.

When the subjects faced to the left in the aircraft, the radiating lines of the star appeared to rotate about the central point to a new position. This rotation was clockwise during deceleration and counterclockwise during acceleration. As the force became smaller, the star appeared to rotate back to its normal position. This illusory rotation occurred at all stimulus levels.

The thresholds of linear deceleration for motion and displacement were 0.067G. and 0.078G., respectively. All of the linear accelerations used were above threshold. The mean maximum rotation during deceleration increased as the decelerative force increased, the maximum estimated rotation reported being 15°.

There was also a positive relation between the maximum force and the duration of the illusory effect. The accelerative effects did not show a consistent variation with the maximum change in the accelerative force.

The results are similar to those observed on a human centrifuge and show that linear

acceleration and deceleration during flight have a marked influence upon visual perception in the dark. Although the observed rotations were small, they were clearly defined and may be considered to be factors contributing to disorientation in pilots.

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SPASTIC ENTROPION CORRECTION: WHEELER'S ORBICULARIS ADVANCEMENT*

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The following case, representative of a series of entropion, is of interest because of its relative infrequency and for the reason that it is a good example of what the proper surgical technique and management can be expected to accomplish in similar cases.

Entropion is less common than ectropion and not as easily nor as permanently corrected. Most operations for this condition depend for their effectiveness on a downward pull, calculated to unroll the inverted lower lid, and on downward traction to prevent turning in of the margin. But not all of these meet the requirements set forth by Spaeth[1] that: "(1) It must relieve the faulty position of the cilia; (2) it must prevent the subsequent recurrence of this faulty position; and (3) it must fulfill the foregoing requirements with the least amount of disfigurement and loss of position of the normal lid border." The last requirement is the most difficult to fulfill.

The problem of spastic entropion has been approached by the application of adhesive strips or adhesive substances and buried sutures, as suggested by Snellen, Gaillard, and Arlt. Others have used skin incisions as suggested by Calsus, von Graefe, Gasson,

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Fig. 1 (Motto and Alexander). Entropion present. Mascara has been placed at the abnormal lid borders.

Panas,[2] and others. Ziegler's[3] method of cauterization, introduced in 1909 and so well advocated by Wiener and Alvis,[4] has become quite popular.

There have been other procedures for correction of spastic entropion not dependent on the downward pull of the lid. Pocnisov[5] advised canthotomy and severance of the attachment of the outer part of the eyelid to the orbital margin. Goldzieper[6] and Blaskovics[7] made lateral traction on the skin of the lower eyelid by removal of a triangle of skin over the zygomatic region. A free canthotomy and a readjustment of the edges at the outer canthus with sutures to hold the lower flap outward during the healing was suggested by Vogt.[8] The injection of 95-percent alcohol into the muscle at the outer canthus was advocated by Hughes[9] in that it weakened the action of the orbicularis.

These means of attempting to correct the problem often result in failure to meet Spaeth's criteria. The condition tends to recur or correction results in disfigurement and loss of normal lid-border position.

Fig. 2 (Motto and Alexander). Left lower lid is everted under tension. Pathologic lid border marked by mascara.

It was thought by one of us (P.M.) that the technique advocate by Wheeler might most satisfactorily fulfill these requirements. The operation has been performed on 7 patients, 4 private and 3 from the clinic service. The sixth case is being presented at this time.

Case report

P. E., a white man, aged 81 years, received a diagnosis of spastic entropion. Ocular tension was 20 mm. Hg (Schiøtz) in both eyes, and the fields were normal. The muscle balance was within the physiologic range of normal.

Fig. 3 (Motto and Alexander). Site of primary skin incision. (From *The Collected Papers of John Martin Wheeler.*)

The upper lids were in good position as to cilia and lid border, but senile atrophy of the skin surface was present. The lid border and cilia of the lower lids were turned inward against the conjunctiva (fig. 1). This eliptical area measured 7 mm. at its greatest width from the normal to the pathologic lid border (fig. 2). The lid could be easily everted with finger traction, but on release of traction and gently closing the eye, the lid border again turned inward.

The condition of the palpebral conjunctiva was not remarkable, but the bulbar conjunctiva had slight and superficial injection. The corneas were clear. The anterior cham-

bers were clear and without flare upon slitlamp examination. The iris stroma were of good quality. The pupils were symmetrical, reacting to light and accommodation.

Slitlamp examination of the lens showed opacities that were cortical in position. The media were clear. Fundus examination showed normal discs but marked arteriolar sclerosis. Both maculas showed degenerative changes that extended on to the surrounding retinas.

The patient's uncorrected visual acuity was: O.D., 6/12; O.S., 6/15. His subjective refractive error was: O.D., +2.0D. sph. ⌒ 0.5D. cyl. ax. 180° = 6/7.5; O.S., +2.25D. sph. ⌒ 0.75D. cyl. ax. 180° = 6/7.5; with a +2.75D. sph., he read J1.

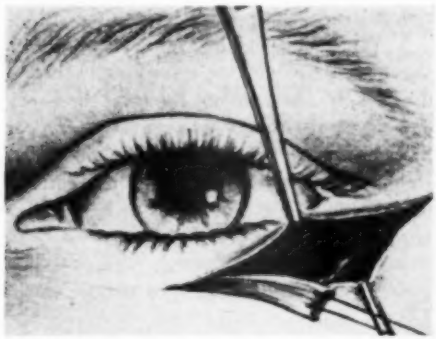

Fig. 4 (Motto and Alexander). Section of muscle dissected from orbicularis oculi. (From *The Collected Papers of John Martin Wheeler.*)

Operation performed

An operation for the correction of the entropion was advised, and the patient consented. Wheeler's operation for spastic entropion without modification was performed. Local anesthesia was obtained by infiltration of the field of operation with a mixture of procaine and adrenalin. The injection was placed in front of the tarsus and tarso-orbital fascia so that the lid was in good position before operation. The anesthesia was carried out over the periosteum at the outer orbital margin.

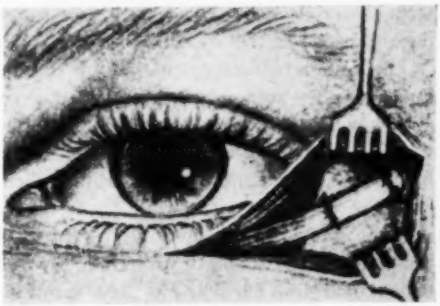

Fig. 5 (Motto and Alexander). Muscle strip in position and sutures in place. (From *The Collected Papers of John Martin Wheeler.*)

The primary incision was made 6 mm. below the normal lid margin through the skin only (fig. 3). The incision was started a little nasally to the center of the lid. Following the direction of the lid margin and parallel to it, the incision was carried about 1 cm. beyond the orbital margin out into the zygomatic region. The skin overlying the orbicularis was dissected free from the incision border up to near the cilia and downward 4 mm. from the incision border.

Following this, a strip of muscle, 4 to 5 mm. wide, was dissected free from the orbicularis oculi, starting at the innermost edge of the skin incision, extending out to the outer orbital rim, and ending at an area opposite the canthus. The dissection swept out and upward, following the anatomic arrangement of the orbicularis fibers. The

Fig. 6 (Motto and Alexander). Postoperative results, one year later.

strip of muscle was then severed at the outer terminal edge of the dissection (fig. 4).

The important placement of the muscle strip was then accomplished by putting it on a stretch and bringing it upward and outward to be attached to the periosteum slightly superior to and lateral to the orbital tubercle. The muscle was attached by two 3-0, chromic gut sutures, one at the end of the muscle and a second a little beyond the orbital margin (fig. 5). The first suture is important for positioning and directing the muscle strip; the second makes its attachment more secure.

The skin wound was closed by fine, interrupted black silk sutures. The lids were covered by a protective tissue. A thin ointment and a secure pressure bandage were placed over the operative site for five days. On the seventh postoperative day one half of the sutures were removed; the remaining sutures were removed on the ninth postoperative day.

Results

The result of this procedure is a permanent correction of the spastic entropion without appreciable scarring or other disfigurement (fig. 6). The lid, well supported in a normal position, is kept from future ectropion or sagging by the muscle strip. The operation has fulfilled the three requirements as outlined by Spaeth: (1) the faulty position of the cilia is corrected; (2) it prevents recurrence; (3) there is little disfigurement and no loss of normal lid-border position.

Summary

1. We have operated on seven cases of spastic entropion according to the method of Wheeler. One case, the sixth, is presented as an illustration.

2. The results have been excellent in all cases and to date there have been no recurrences.

3. We feel that the Wheeler procedure should be employed more frequently because it offers, in our opinoin, the best, the safest, and the most conservative operation for correction of this condition. The lid is well supported. Future recurrence or sagging is prevented by the muscle strip, resulting in normal position of the lid border.

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HIGHER REFRACTIONAL ANOMALIES

THEIR FREQUENCY IN DIFFERENT GROUPS AND COUNTRIES

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I. INTRODUCTION

The higher refractional anomalies do not fit into the pattern of the mathematical curve of a normal frequency distribution. They are not variations within the normal range. The majority represents abnormal conditions. Comparative studies of these anomalies with regard to exogenous as well as endogenous factors are not available.

The purpose of this contribution is to present some data on this subject and to compare them with respect to sex, national characteristics, constitution, and geographic conditions.

II. METHOD AND MATERIALS

This study considers as higher refractional anomalies hyperopias in which +5.0D. and more were prescribed and myopias with a prescription of −7.0D. or more.

The material was obtained from two groups of records.

Group in Nauen. The first group consisted of the records of my former office in Nauen near Berlin, Germany. About 8,000 men and 8,000 women patients of all age groups were examined. The second group of records was studied in New Orleans, Louisiana, thanks to the kindness of Dr. Charles A. Bahn. Files of 4,420 men and 1,570 women patients of all age groups were checked.

The results obtained in Nauen and in New Orleans are considered representative for these areas, not for other parts of the two countries. (A. Statistical findings: Graphs 1, 2, and 3. B. Clinical observations: Table 1.)

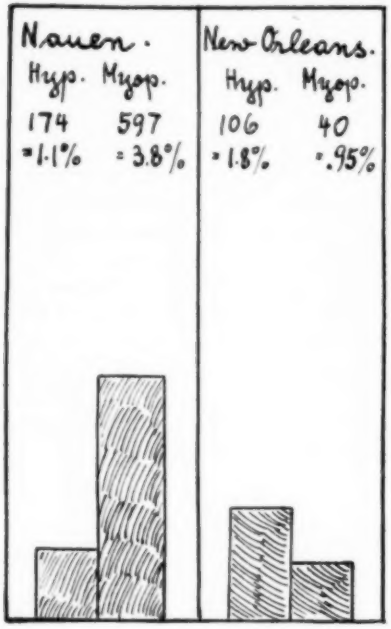
A family history of higher refractional anomalies, especially in the cases of myopia, was not unusual. Excessive myopia was associated with the asthenic as well as with the lateral dysplastic habitus.

TABLE 1

CLINICAL OBSERVATIONS IN THE NAUEN GROUP

	Hyp. ♂	Hyp. ♀	Myop. ♂	Myop. ♀
I. Both eyes affected	111 out of 114 Cases	59 out of 60 Cases	220 out of 265 Cases	274 out of 332 Cases
II. Very large temporal conus or pronounced peripapillary changes		1	68 times in both eyes 12 times in one eye	97 times in both eyes 15 times in one eye
III. Large conus pointing downward	1		6 times in both eyes 8 times in one eye	6 times in both eyes 4 times in one eye
IV. Coloboma of the optic nerve Coloboma of the iris	1	1	3 3	4
V. Signs of phlyctenular, keratoconjunctivitis, maculas, corneas (1)		1	19	18
VI. Muscles: Strabismus convergens Strabismus divergens Nystagmus	13	9	 5 4 3	 3 8 1
VII. Signs of syphilis Signs of tuberculosis			6 3	4 5

Other observations were: High hyperopia appeared rather stationary from the beginning in early childhood,[2] high myopia was progressive for many years.[3] The extreme degrees of myopia were found more often in women than in men.[3] The youngest patient examined under atropine was a girl, aged 3 weeks, having a myopia of −18.0D. The highest degree of myopia[4] found in



Graph 1 (Schmerl). Representation in percentages of the frequency of higher hyperopia in comparison with higher myopia in Nauen, Germany, and New Orleans, Louisiana.

boys under 8 years of age was −14.0D. (atropine); in girls under 8 years of age, −20.0D. (atropine).

The higher hyperopics showed less outspoken deviations from both the normal linear and the normal lateral type of Stockard.[5] However, sometimes mental abnormalities were noticed.[6] High hyperopics frequently were difficult to handle. The population around Nauen consisted of Germans markedly mixed with Slavs (Wenden).

Group in New Orleans. Fourteen cases of high myopia were seen during 18 months as assistant to Dr. Bahn. They included 3 male and 11 female white patients. Six patients did not show any abnormalities of the fundus; 2 twin girls had practically the same refractive error and presented coni of medium size. In another patient a nasal conus was observed, and in 2 more patients, coni pointing downward. Only 3 of the 14 cases showed major peripapillary changes. A family history of myopia was extremely rare. The constitutional types of progressive myopia seemed to be the same as in Nauen. Among the hyperopics, body types were seen as described by Hooton.[7] This will be discussed later on.

As to nationality, the practice predominantly consisted of patients of French, English, and Irish extraction, and of smaller groups of German, Italian, and Spanish origin. In both groups, in Nauen and in New Orleans, the number of Jews was negligible. This is mentioned because higher myopia is rather frequently seen among the Jewish population; for instance, in New York.

III. Discussion

At the beginning of the discussion it has to be repeated that the findings reported here do not permit any generalization. In other geographical zones with other national groups, different results are probable. However, some of the statements of this study might find confirmation, such as the observation that excessive myopia occurs in the asthenic as well as in the lateral dysplastic habitus. So the problem of refraction and constitution might be discussed first.

1. Refractional anomalies and constitutional types. Stockard mainly considered two groups of normal bodybuild—the linear and the lateral type. The asthenic and the lateral dysplastic habitus would represent the pathologic extremes of these two groups. In many cases the excessively myopic eye, no less than the glaucomatous eye, is a diseased organ in a diseased body. It is not surprising to find it in the body of any extreme constitutional type.

The literature on the subject of high re-

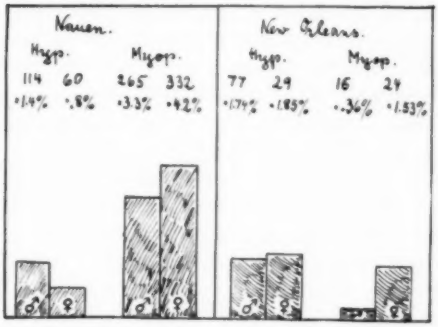
fractional anomalies and constitution is somewhat confusing. National differences and the differences between the normal and the pathologic constitutional types are not sufficiently taken into consideration. The difficulty in differentiating between normal and pathologic variates of refraction further confuses the issue.

This in part explains why Stockard, in this country, enumerated as characteristics of the linear type: Dolichocephaly, short interpupillary distance and frequent farsightedness; and as characteristics of the lateral type: Brachycephaly, wide interpupillary distance and frequent nearsightedness.

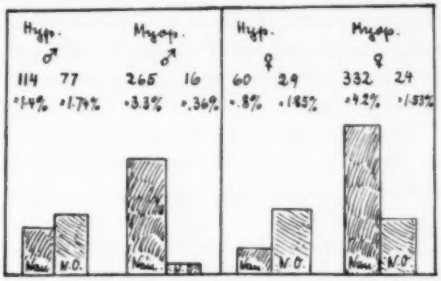
E. Francke[8] (Berlin, Germany), however, found myopia more often in the leptosomic (linear) type; hyperopia more often in the pyknic (lateral) type. Excessive myopia was often encountered in dysplastic types.

Similar results had been obtained by Incze;[9] and Steiger,[10] in Switzerland, had found an increase in the corneal curvature combined with a decrease in the interpupillary distance. Further data relating to this problem can be found in Erggelet's[6] contribution.

In the hyperopics of New Orleans a constitutional type was rather frequently seen as described by Hooton[7] who refers to the children of European immigrants saying: "One gains the impression that the squat build of the parent associated with a broad



Graph 2 (Schmerl). Representation in percentages of the frequency of higher refractional anomalies in males in comparison with females in Nauen, Germany, and New Orleans, Louisiana.



Graph 3 (Schmerl). Representation in percentages for each sex of the frequency of higher refractional anomalies in Nauen, Germany, in comparison with New Orleans, Louisiana.

short face has been transformed into a more weedy and linear body type in which horizontal dimensions have been compressed and vertical diameters stretched." It is this type of linear bodybuild which, derived from the more lateral habitus, remarkably often shows high hyperopia.

Bourgeois and Tscherning[11] have noted a decreasing corneal curvature combined with an increase in body size and skull circumference, and, according to Steiger, hyperopia more often combines with less curved, myopia with more curved, corneas. With Hooton's views in mind, a correlation between change in body type and increased frequency of hyperopia in New Orleans becomes understandable.

2. High refractional anomalies and sex. Although off and on the opinion was expressed that high myopia occurs more often in the female than in the male, few quantitative statements can be found. Jackson[4] in Denver, Colorado, had seen high myopia in 2 boys and 7 girls. Blegvad[5] in a large Danish eye clinic found myopia of —6.0D. and more in 1.14 percent of men and 2.64 percent of women. Our own material shows that the differences in both sexes are marked. In New Orleans this difference is due mainly to the fact that high myopia is practically nonexistent in males.

Instead of offering an explanation for this difference in frequency encountered in males and females, it might suffice to bring to mind that in keratoconus and in glaucoma similar

conditions exist. Reports of positive Aschheim-Zondek reactions[12] found in high myopia and in keratoconus point to endocrine disturbances.

The prevalence of high hyperopia in males as found in Nauen has not been described before. This difference was missing in New Orleans.

3. High refractional anomalies and national and geographical factors. The national differences between the populations in Nauen and in New Orleans were mentioned above. It seems that excessive myopia occurs rather frequently in the German-Slav group, as seen in Nauen. It is also rather often found among Jewish people. Finally, I have seen a number of cases of progressive myopia among the Irish population of this country.

No doubt, it is difficult to evaluate to what extent refractional anomalies are due to national characteristics, how far they are due to constitutional, geographic, or pathologic circumstances. Steiger, for instance, had his doubts about national differences with regard to myopia, and, as an illustration for his belief, he mentioned the Irish and the German nationalities. However, these are just two groups in which myopia seems to occur more frequently.

Kronfeld and Devney[13] also did not seem to be inclined to ascribe much importance to the fact that they had found more myopia of a slight and moderate degree in Chicago than Scheerer and Betsch[14] had found in Tuebingen, Germany. But southern Germans differ markedly from northern Germans among whom the pyknic type, as described by Kretschmer,[15] is rather common, and, as Francke and others had found, this type usually combines with hyperopia. Therefore, small as the difference between Kronfeld's and Scheerer's values is, it seems to be of biologic significance.

In agreement with our findings Kronfeld[16] states that high myopia is more prevalent in Europe than in America, and Novak[17] has found more hyperopia in Iowa than in Vienna.

4. High refractional anomalies and malformations and general diseases. In a number of cases of excessive myopia, errors of development seem to be the causative factors. For instance, in cases in which a coloboma of the optic nerve or a large conus pointing downward occurs in but one eye, the myopia was probably caused by an accident in utero.

Among the general diseases connected with excessive myopia, tuberculosis has been mentioned repeatedly.[18] Our own observations justify the statement that, in addition to constitutional, national, and many other factors, tuberculosis and other diseases play a part in the production of progressive myopia in a number of cases.

The rather frequent occurrence of phlyctenular keratoconjunctivitis in high myopia, general signs of tuberculosis, and positive family histories are in favor of this view. It should also be remembered that the asthenic habitus predisposes to tuberculosis as well as to excessive myopia.

Several times the progress of myopic conditions could be observed while a congenital syphilitic keratitis developed.

IV. Summary and Conclusions

A number of statistical statements and clinical observations are presented for the purpose of demonstrating: (1) The correlations which exist between higher refractional anomalies and the factors of nationality, constitution, and sex, and, (2) the differences in frequency of higher refractional anomalies which exist in different parts of the world.

It is hoped that this contribution will stimulate better and more specific studies in the field of constitutional ophthalmology.

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I am indebted to Dr. Charles A. Bahn of New Orleans, Louisiana, for permission to use his records and for many suggestions.

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OCULAR MYASTHENIA GRAVIS*

Report of two cases

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The majority of reports on myasthenia gravis have been made by neurologists, but since the disease may start with purely ocular manifestations, the ophthalmologist is often the first to be consulted. Indeed, as in one of the two cases about to be reported, the disease may remain localized to the eyes for many years. The ophthalmologist must, therefore, be familiar with and always suspicious of the transient, evanescent, and extremely variable manifestations of this rare illness.

Myasthenia gravis was described by Erb, in 1878, and Goldflam, in 1893, but was first named by Jolly,[1] in 1895; the modern era of diagnosis and treatment began in 1935 with the discovery of the striking efficacy of prostigmin by an English ophthalmologist, Mary B. Walker.

* Presented before the New York Academy of Medicine, Section on Ophthalmology, November 17, 1947.

Description of disease

The disease is clinically characterized by a syndrome which comprises marked weakness and fatigue and, in some cases, actual wasting of muscles without any characteristic pathologic changes. There is no predisposition for sex and the disease may occur at any age with the greatest frequency in the third and fourth decades. The onset of the disease has been reported in persons as young as 11 months and as old as 75 years of age. Heredity plays no role. The symptoms may be alleviated by pregnancy and the disease does not interfere with normal labor. Very often the affection first manifests itself after a respiratory illness and such an infection is prone to intensify the symptoms in an established case.

Etiology

The causation of myasthenia gravis is unknown, but it is believed that there is an

insufficiency of acetylcholine or a similar substance at the myoneural junction. The motor impulse is therefore not transmitted across the junction. The inadequacy of the cholinelike substance at the motor end-plates is due either to underproduction or to rapid destruction by an overabundance of acetylcholine esterase, a substance whose normal function is to destroy acetylcholine.

Walker[2] recognized the similarity between the paralysis of mild curare poisoning and the symptoms of myasthenia gravis and first used eserine and later prostigmin because of their decurarizing effects. These two closely related substances have a protective influence on acetylcholine by rapidly breaking down cholinesterase.

Symptomatology

The diagnosis rests upon the demonstration of rapid fatigue and weakness of muscles. This is easily accomplished in patients suffering from myasthenia gravis by repeated opening and closing of the eyes or mouth, opening and closing the hand, leg raising and similar movements designed to tire an affected muscle. Recovery occurs on resting that muscle.

Ocular signs

There appears to be a predisposition for involvement of groups of muscles innervated by cranial nerves. The extraocular muscles together with the orbicularis oculi and the levator palpebral superioris are usually involved. The functions of the extraocular muscles are particularly sensitive to the acetylcholine mechanism.[3] Their sensitivity to acetylcholine is unlike that of any other skeletal muscle. It is not surprising, then, that a general disturbance in acetylcholine utilization should first manifest itself and most profoundly in the extraocular muscles.

In Mattis's[4] series of cases, 96 percent manifested ocular symptoms at some time during the disease. Of importance to the ophthalmologist is his figure of 65 percent of cases manifesting the presenting symptom in the eyes. Presumably, therefore, 65 percent of persons affected with myasthenia gravis present themselves to the ophthalmologist with their initial complaints.

Ptosis is most frequently the first symptom, being present in 46 percent of all cases. Diplopia is the initial complaint in 34 percent of cases.

Occasionally, there are cases that exhibit no signs or symptoms other than those referable to the ocular apparatus. Of note is the case reported by Gavey[5] in which the disease remained localized in the eye over a period of 25 years, during which time the diagnosis was in error. Although, statistically, ocular signs and symptoms are most frequent, their correct etiologic basis is often not recognized until other unmistakable concomitants have appeared. One could speculate as to the frequency of cases of monosymptomatic ocular myasthenia gravis that are erroneously diagnosed as neurasthenia, psychosomatic aberrations, neurosyphilis, organic oculomotor palsy, and similar neurologic conditions.

Diplopia

Double vision may be present even when there is no visible evidence of limitation in the ocular excursions. In mild cases there is danger of the condition being considered functional. The extraocular muscle involvement may be so mild as to affect only one muscle. On the other hand, it may be so extreme that a picture of complete external ophthalmoplegia is produced with complete paralysis of rotations in all directions.[6]

Limitation of movement of the eyes may be unilateral or bilateral and in any direction. Sometimes, there is a close resemblance to supranuclear paralysis of conjugate movement.

Muscle balance tests vary from time to time. The diplopia is so variable that classification is not possible except in a few cases of the most stable involvement. Cases with minimal diplopia may persist for a long time.

When cases of this nature with obscure

etiology are encountered, attempts at mapping out the diplopia produce an increasing separation of images due to fatigue; this so called myasthenic reaction is the clue to the correct etiologic diagnosis.

In those cases of pronounced limitation of ocular motility, ptosis is invariably severe and bilateral. These cases of myasthenic ophthalmoplegia exhibit a pronounced resistance to improvement when prostigmin is administered. While the ptosis is invariably improved by prostigmin, the extraocular muscle palsy improves slightly, if at all. It is possible that, in such cases of almost complete external ophthalmoplegia, permanent structural changes may have occurred.

The most constantly observed defect in proved cases is the presence of convergence insufficiency. Mattis[4] coined the terms "drifting phoria" and "transient tropias" to illustrate the variability of deviations when measured by prisms.

The variability is due to fatigue and prevents accurate measurements. Once the deviations are corrected by prisms, active deductions are no longer needed, recovery from fatigue occurs, and reversals from exophoria to esophoria or visa versa occur.

Ptosis

This may vary from complete to mild ptosis and increases rapidly on successive attempts on looking upward. After repeated attempts at elevating the lids, the ptosis becomes more marked. Characteristically, the ptosis becomes most marked when the patient is fatigued. It is, therefore, most marked at the end of the day and minimal on arising in the morning.

Lid retraction in one eye associated with ptosis in the fellow eye has been described by Walsh.[7] This is regarded as evidence that the smooth muscle fibers of the upper lid are not involved in myasthenia gravis. Walsh describes cases of abnormal movements of the upper lid associated with ocular rotations similar to cases of regeneration of the third nerve with misdirection of fibers.

The strength of the orbicularis oculi also fails rapidly. Inability to close the eyes tightly is frequently present and increases on repeated squeezing of the lids. Lagophthalmos with exposure keratitis has been reported.

In spite of the imbalance of the acetylcholine mechanism, there are no abnormalities of the pupils or their reactions. There are likewise no changes in accommodative power.

Facial weakness, usually bilateral, is frequently present. This produces a flattening of the face and the so-called myasthenic snarl, since the retractor muscle at the corners of the mouth are more severely affected than the elevators. Weakness of the jaws, soft palate, and pharynx produces difficulties in speech and swallowing.

Weakness of the chest muscles and diaphragm may cause dyspnea and respiratory embarrassment. Weakness of the muscles of the trunk and extremities are frequent. Aside from the weakness there are no focal neurologic signs. Tiring of the knee jerk is said to occur and to recover after a brief rest.

Diagnosis

Electromyographic, electroergographic methods and such other tests as the Jolly reaction can be used to ascertain the state of skeletal muscle function.[8] However, as Moore[9] points out, all these methods are either unsuitable for testing ptosis or require cumbersome and elaborate apparatus. Fortunately, the prostigmin test is much more reliable, simpler, and more practical.

The use of prostigmin for diagnostic purposes has been extensively studied by Viets, Schwab, and Mitchel.[10] This simple test consists of the intramuscular injection of 1.5 mg. of prostigmin methylsulphate plus 0.6 mg. of atropine sulphate to overcome the abdominal cramps. The observation of subjective and objective improvement is observed at 10-minute intervals for one hour.

The test is absolutely diagnostic for myasthenia gravis alone and will not produce

improvement in muscle power in any other disease. No apparatus other than a syringe and needle is needed for the test. The symptoms of myasthenia are intensified by quinine which may be used to substantiate the diagnosis.

Treatment

While prostigmin methylsulphate is rapid in its action, its effect is of brief duration. The bromide salt taken orally is more suitable for maintenance therapy and can be taken in 15-mg. tablets. Sufficient tablets are taken to produce a remission and from 3 to 25 tablets may be taken daily.

Viets[10] emphasizes the importance of prescribing adequate amounts of prostigmin ("what is usually called developing a tolerance to the drug is merely an acknowledgment of inadequate dosage"). As a rule, the oral dose is about three times that by injection.

That this therapy is not without danger is indicated by the report by Nielson[11] of a death due to bromidism in a patient taking 16 tablets daily. Other antimyasthenic drugs that may be used in conjunction with prostigmin are potassium chloride, ephedrine sulphate, and quanidine hydrochloride.

While most patients are benefited by increased muscle power, many are still bothered by intermittent diplopia or ptosis. It is not possible to correct the diplopia with prisms because of the extreme variability.

Report of two cases

Case 1

History. A. M., a 43-year-old Italian woman, was first observed on April 24, 1947. Her presenting complaint was double vision which had been present for one month. There had been one previous episode of double vision 14 years earlier, at which time the patient had been told that she had had a "stroke." With the administration of eye drops, the double vision had subsided in a few weeks. There were no recurrences until the present episode.

No history of fatigue or weakness, or of articulation, mastication, or swallowing difficulties could be elicited. There was no history of temperamentality, hysteria, or emotional upset. She did not complain of discomfort in her neck or chest or of chronic cough or sputum. Her daily work, in a factory, caused no unusual fatigue of the muscles of the extremities.

Her diet had been excessive in carbohydrates. She took no alcohol or tobacco. There had been a weight gain of 100 pounds since a pregnancy 16 years previously. She had had pleurisy 15 years ago, a left mastoidectomy as a child, and a laparotomy for "internal adhesions" at the age of 30 years.

Menstruation had been normal, although the menarche was at the age of 9 years; no symptoms of menopause had yet appeared. The Wassermann reaction had been negative in 1946.

Ocular examination. There was no ptosis and no wrinkling of the brow. The ocular excursions were full with no evident restrictions. There was no weakness of the orbicularis oculi and no undue fatigue on squeezing the lids.

Diplopia was present in the field of the left superior oblique muscle only; there was no diplopia except on looking down to the right. On attempting to chart the diplopia field with the aid of a red filter, it was observed that the diplopia kept increasing as the examination continued.

The patient was allowed to rest and then the diplopia field was reëxamined. The same phenomenon was again observed; namely, increasing separation of images as the testing was prolonged. It was not possible to elicit diplopia in the field of any other ocular muscle even after fatigue.

Slight lid lag was present bilaterally. There was no convergence weakness. Exophthalmometric readings with the Hertl exophthalmometer set at 96 was 12 mm., O.U.

Visual acuity was: R.E., 20/200; L.E., 20/400. A marked degree of compound hyperopic astigmatism was present and the

vision was correctible to 20/25, O.U.

Except for a small corneal scar the anterior segments of the globes were normal. The pupils were round and equal and reacted to light and accommodation.

Examination of the ocular media and fundi revealed no pathologic changes; there were a few opaque nerve fibers on the right nervehead. There were no constrictions or scotomas in the visual field. The intraocular pressure was 22 mm. Hg (Schiøtz), O.U.

General physical examination revealed an obese woman, weighing 230 pounds. There was no abnormal facial expression; she was able to laugh, frown, and wrinkle her forehead with ease. There was no evident impairment of speech, chewing, or swallowing. Gait and station were normal. The deep reflexes were equal and active, and there were no pathologic reflexes. The muscle power was good. There were no abnormalities of superficial or deep sensation.

There was a left mastoid scar. The gums were slightly spongy and the teeth were in need of repair. There was no thyroid enlargement. The lungs were clear. No evidence of enlarged thymus was present. The breasts were large and contained several glandular nodularities. The heart was not enlarged; the sounds were of good quality. A_2 was greater than P_2. The rhythm was regular. Blood pressure was 130/90 mm. Hg.

There was a scar in the right upper quadrant, but there were no abdominal masses or tenderness. On vaginal examination, the fundus was found to be slightly enlarged; there were no adnexal masses. The lower extremities contained many varices but there was no pitting edema.

On fluoroscopy, the lungs were clear and the heart was not enlarged. The basal-metabolism rate was −5 percent. The urine had a specific gravity of 1.024, with a very faint trace of albumin and no glucose; there was an occasional W.B.C. The hemoglobin content was 85 percent (Sahli).

Course. The only positive finding was diplopia due to paresis of the left superior oblique muscle. Diplopia increasing with fatigue was indicative of a myasthenic reaction and prostigmin methylsulfate (1.5 mg.) combined with atropine sulfate (0.6 mg.) was administered subcutaneously.

The diplopia disappeared within five minutes and could no longer be elicted with the aid of fatigue and a red filter. The patient had a sense of strength and well being that had not previously been present. Except for spasm of both masseter muscles, there were no ill effects from the injection.

The patient was placed on an oral maintenance dose of three tablets of prostigmin bromide (15 mg.) daily. There was no diplopia throughout the day and the sense of well being persisted. The effect of one tablet lasted about four hours and then diplopia would appear. The patient was able to regulate the medication herself, depending on the appearance of diplopia.

Case 2

History. J. C., a 42-year-old Negro, was first observed on May 28, 1947, complaining of double vision. The diplopia had been present since February, 1947. At that time he was employed as a laborer and he attributed his difficulties to exposure to a welder's arc light.

Difficulty in elevating the left upper lid appeared soon after the diplopia and increased rapidly. There had been no difficulties in speech, mastication, or swallowing. No history of weakness or fatigue could be elicited. There was no cough and no respiratory difficulties.

In 1945, a mild craniocerebral trauma was sustained with no postconcussion symptoms. About 10 years ago he had received intravenous and intramuscular injections for "the blood." The Klein reaction was negative in 1946.

Ocular examination. Almost complete ptosis was present in both eyes with only a 3-mm. palpebral fissure present, O.U. (fig. 1). The ptosis increased on successive attempts at looking up. Compensatory wrin-

kling of the brow was marked and the patient walked around with his head thrown back. The power of the orbicularis oculi was extremely poor and diminished rapidly on forced closure of the lids.

All movements of both eyes were considerably diminished and the eyeballs could not be rotated beyond 15 degrees from fixation. There was almost complete paralysis of every extraocular muscle, as well as inability to rotate the eyes conjugately. The oculocephalic reflex (Bielschowsky phenomenon) produced no increase in motility. Complete paralysis of convergence was present. Diplopia was present in all cardinal fields of gaze and could not be mapped because of the extreme variability.

Fig. 1 (Lisman). *Case 2.* After repeated attempts at elevating the lids, almost complete ptosis was present.

Visual acuity was: 20/200, O.U., correctible to only 20/40. There were no abnormalities of the conjunctiva or corneas. The pupils were small, equal, and regular and reacted very sluggishly to light and for near.

Study of the ocular media and fundi revealed the presence of a recent retinal exudate just nasal to the optic disc in the right eye. The intraocular pressure was 22 mm. Hg (Schiøtz), O.U. The visual fields were tubular and constricted to 15 degrees with various sizes of test objects.

General physical examination. Examination revealed a well-developed, adequately nourished adult Negro. The head was symmetrical and ausculation was negative. There were no difficulties in speech, mastication, or swallowing. The jaw opened in the midline. Air conduction was equal bilaterally and the Weber test was properly lateralized. The uvula elevated in the midline and the tongue was without tremor or deviation. The tonsils were markedly enlarged.

Grips were good and equal bilaterally. There was no drift or tremor of the extended hands. The finger-to-nose test was well performed.

The abdominal reflexes were equally active in all quadrants. The reflexes of the upper and lower extremities were present and equal bilaterally. There was no Babinski reaction. Vibratory stimulus was appreciated and there was no disturbance in position sense.

Gait and station were normal. A complete left hemisensory syndrome was present with loss of superficial and deep sensibilities sharply delineated by the midline.

The chest was clear. There was no cardiac enlargement, the sounds were of good quality. Blood pressure was 120/70 mm. Hg. The urine examination revealed a specific gravity of 1.014 without cells or albumin. Skull X-ray examination revealed no abnormal findings. The blood Wassermann reaction was negative. The spinal fluid was clear under normal pressure, and there were no cells or increased protein.

Course. The patient was given an intramuscular injection of 1.5 mg. of prostigmin methylsulfate and 0.6 mg. of atropine sulphate. Within 10 minutes there was marked improvement in the ptosis, increased power of the orbicularis oculi and enormous increase in ocular motility.

The ocular excursions were improved but not normal and diplopia still persisted in all fields. The patient stated that he felt much stronger and full of vigor.

The tubular visual fields and the hemisensory syndrome were considered manifestations of hysterical superimposition. The patient was a shiftless, unreliable individual who disappeared from observation before

maintenance doses of prostigmin could be determined.

Comment

The subjective and objective manifestations of muscular weakness in these two cases were limited to the eyes alone. The response to prostigmin was diagnostic of myasthenia gravis.

If the first episode of diplopia is accepted as the first symptom in Case 1, the disease had probably been present for at least 14 years. During all this time no other evidence of muscular weakness had appeared. The disease was mild and the remission complete.

In Case 2, the manifestations of muscular weakness were likewise localized strictly to the eyes. The disease was rapidly progressive and there was a remarkable resemblance to complete external ophthalmoplegia of supranuclear origin. Indeed, the picture was puzzling until the diagnostic injection of prostigmin.

This is the type of case that responds poorly to prostigmin. The ptosis is invariably improved but it is almost impossible to induce a complete remission of the diplopia and the possibility of permanent muscular changes must be considered. There was no response to doses of prostigmin less than 1.5 mg.

These two cases illustrate the marked improvement in muscle tone and general well being after prostigmin is administered to patients who previously had no complaints and manifested no evidence of fatigue.

The ocular manifestations of myasthenia may herald the onset of the disease which rapidly spreads to involve the muscles of the trunk and extremities. On the other hand the disease may be mild as in Case 1, with a remission lasting for many years and then becoming manifest by paresis of only one of the extraocular muscles.

It is interesting to speculate as to how many cases of "functional" diplopia, transient convergence weakness, and mild transitory ptosis are really early cases of myasthenia gravis.

Summary

1. Two cases of myasthenia gravis are presented.

2. The diagnosis was not apparent until after the injection of prostigmin.

3. The signs are localized to the eyes alone.

4. The muscular weakness was confined to only one of the extraocular muscles in Case 1. In Case 2, the appearance was that of a complete external ophthalmoplegia.

654 Madison Avenue (19).

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NOTES, CASES, INSTRUMENTS

DIGITOXIN INTOXICATION

Resulting in retrobulbar optic neuritis

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Digitalis intoxication, as an etiologic factor in the production of retrobulbar optic neuritis, has been reported by Wagener and others.[1] Theirs was the first case to be published in ophthalmic literature. Another instance of retrobulbar optic neuritis, resulting, however, from digitoxin therapy, is being presented.

Report of case

History. An optometrist referred a 47-year-old white man in no acute distress but with the presenting complaint of blurriness of vision in both eyes. Four weeks previously, severe right- and left-sided cardiac decompensation had occurred. For this, therapy with digitoxin (0.2 mg.) was initiated, the frequency of dosage administered being one tablet, three times daily for one week; thereafter, one tablet, twice daily.

During the first two weeks of therapy, there were no complaints. With the onset of the third week, fogginess of vision and inability to read suddenly came on, the diminished visual acuity being pronounced during the day but, in contrast, becoming slightly improved with the approach of dusk.

At no time were there present any general toxic symptoms. The earliest effects of digitalis overdosage—anorexia, nausea, and vomiting—were absent. There was no headache, fatigue, malaise, drowsiness, or delirium. Alterations in cardiac rate and rhythm did not occur. Neither was there any diarrhea, abdominal discomfort, nor pain. Significantly, chromatopsia was absent.

Eye examination. At the time of the ocular examination, a total of 5.4 mg. of digitoxin had been used. Uncorrected visual acuity in the right eye was 20/200, and in the left eye, 20/200−1. Corrected vision was: R.E., 20/100−2; L.E., 20/100−1. Externally, there was present in both eyes 4.5-mm. mydriasis with very sluggish reaction to light and with the contraction not being maintained in continued bright light. Biomicroscopic and ophthalmoscopic examinations were essentially normal.

Under reduced illumination the central visual fields at a distance of one meter revealed the following: (1) Slight enlargement of the cecal areas; (2) pericentral scotomas with a 1-mm. white test object—5 degrees in the right eye and 10 degrees in the left eye; (3) denser pericentral scotomas within each scotoma with a 2-mm. white test object—3 degrees in the right eye and 5 degrees in the left eye.

Treatment and course. Thiamine chloride (20 mg., 3 times daily) was immediately prescribed. The seriousness of the patient's cardiac condition did not warrant discontinuance of digitoxin therapy. After 10 more days of the same dosage, digitoxin was reduced to one tablet per day. On the 4th day of reduced digitoxin therapy the vision was observed to improve subjectively.

On the 7th day of reduced dosage, the uncorrected vision was: R.E., 20/60−1; L.E., 20/80−1. The right eye had a 4-mm., sluggishly reacting pupil; the left eye a 3.5-mm., promptly reacting pupil. The central fields showed reduction in the size of the pericentral scotomas—in both eyes a 5-degree scotoma with a 1-mm. white test object, and a 2-degree denser scotoma with a 2-mm. white test object.

After four weeks of reduced therapy, uncorrected vision in the right eye was 20/50−1; in the left eye, 20/70. The pupils of both eyes were normal. Further reduction in the pericentral scotomas occurred —with a 1-mm. white test object: R.E., 3 degrees, L.E., 4 degrees; with a 2-mm. white test object: R.E., 0.5 degree, L.E., 1 degree.

At this time, the patient volunteered the observation that, upon arising in the morning, vision was clear, but that, after taking the 0.2 mg. digitoxin tablet, some smokiness of vision would recur and would persist throughout the day.

On the 6th and 7th weeks of reduced dosage, the 2-mm. and 1-mm. white test object pericentral scotomas remained approximately the same in circumference. Corrected vision was: O.U., 20/30.

During the 9th week, when digitoxin was not used for a 3-day period, there was complete absence of "smokiness." Corrected vision was 20/25 in both eyes, and the pericentral scotomas were the same in size.

Discussion and Comment

This case presents the problem of digitoxin in ophthalmic toxicology. Hermann and others[2] reported that digitalis poisoning had been more frequent in recent years. This was ascribed to the more generally active and stable commercial preparations and the confusion concerning the activity of the highly potent glucoside preparations now available. Of the glucosides, digitoxin seems to remain active the longest and hence is the most likely to be concerned in cumulative poisoning.

A comparison between digitoxin and digitalis should be of interest to an ophthalmologist. According to Gold and others,[3, 4] digitoxin possesses the action and uses of digitalis with the advantages of complete and more rapid absorption from the gastrointestinal tract, almost complete lack of gastric irritation, and the uniformity of potency characteristic of a pure or almost pure crystalline substance.

Its complete and rapid absorption from the tract and the infrequency of gastric irritation enables the physician to give the full digitalizing dose (about 1.2 mg.) at one time orally and to produce the full digitalis effect in 6 to 8 hours after its ingestion.

Digitalis powder or tincture has, in contrast, incomplete, slow, and variable absorption, local gastric irritation preventing the administration of the full amount in a single dose, a potency 1,000 times less than digitoxin, and the ability to produce full digitalization in 24 to 48 hours. The cumulation and elimination of digitoxin is similar to that of digitalis powder. It is likely, therefore, that the old type digitalis powder and tincture preparations, being less potent, have not figured prominently in ophthalmic toxicology in the past.

Digitoxin has a selective affinity not only for the vagi, the sino-auricular, and auriculoventricular conduction systems, but also, as noted by Wagener, the papillomacular bundle. Through this selective papillomacular bundle affinity, it causes a bilateral central or centrocecal scotoma. (I have had one case in which a centrocecal scotoma was present.) The possibility of direct damage to the optic nerves secondary to generalized systemic intoxication was postulated by Wagener. The mode of action is problematical, however, and may be either neurotoxic or vasotoxic. If vasotoxic, vasoconstriction and thereby secondary neurogenic degeneration through nutritional deficiency may explain the nerve damage. The experiments of Danielopolu[5] suggest a possible mechanism of action in the accumulation of acetylcholine through the inactivating action of digitalis on cholinesterase.

Summary

A case of retrobulbar optic neuritis resulting from digitoxin intoxication is presented. The case is unusual because the only presenting symptom of digitoxin intoxication was that of blurriness of vision.

Since digitoxin is almost completely absorbed and produces almost no gastric irritation, nausea is rare. It is likely, therefore, that a central scotoma may be the early sign of digitoxin poisoning. That thiamine chloride may be of value in the therapy of digitoxin retrobulbar optic neuritis is suggested by the progress of the case presented.

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CYSTICERCUS OF THE VITREOUS

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A Mexican man, aged 21 years, working as a section laborer, arrived at the hospital with a diagnosis of traumatic retinal detachment of the right eye.

Report of an unusual case

History. On April 18, 1945, while the patient was working with a pick on a track section he struck a large rock and a piece flew up and struck his right eye causing severe pain and immediate loss of vision. He was taken to a local physician who found only a small superficial abrasion and limited ecchymosis of the right upper lid. He was told that there was no foreign body in his lid or eye and that he could return to duty, but he found the eye too painful to continue work and returned for further examination and treatment. He was sent to a local ophthalmologist who sent him to San Francisco with a diagnosis of traumatic retinal detachment.

Eye examination. He was first seen in the eye clinic on April 23, 1945, five days after his alleged injury. The vision at this time was: R.E., light perception; L.E., 20/20+.

The right upper lid showed evidence of a slight abrasion with some edema and a little discoloration. The pupil had been dilated with atropine and an examination showed a dark-gray floating detachment which hung down so far that the disc could just be seen. The peripheral fundus below appeared normal. This confirmed the entrance examination of traumatic retinal detachment. However, no tear could be seen which made us suspicious that it might be a neoplasm or cyst. Transillumination was completely negative in several succeeding examinations. No tear could be located.

The patient's eyes were bandaged and he was kept flat in bed with limited fluid intake and sedatives in an effort to reduce the size of the detachment and find a retinal hole.

Physical examination. The blood showed a normal red count with 100-percent hemoglobin; a white count with 7,000 leukocytes, 62-percent neutrophiles, 22-percent lymphocytes, 8-percent monocytes, and 8-percent eosinophiles. The urine examination and Kolmer and Kahn tests were negative. A stool examination showed Endamoeba coli, Iodamoeba buetschlii, and blastocytes. No ova or segments were seen.

Course. On May 1st and 2nd, during the time he was flat in bed to reduce the detachment, the patient developed a severe headache over the right eye with nausea and vomiting. Examination of the eye showed no change, the detachment seemed to be smaller, the tension normal, but no tear could be located.

Unfortunately, the first material vomited was not examined, but gross examination of the succeeding attacks showed no segments or section of worm or anything to arouse our suspicions as to the presence of a cestode.

There were no further headaches or nausea after May 2nd. Since the retinal condition remained unchanged and no disinsertion or tear could be located, it was decided

I wish to thank Dr. Michael J. Hogan for his efforts in preparing the sections shown in the illustrations.

to operate on May 27th. Further transilluminations disclosed no shadow to indicate a neoplasm and the detachment was floating freely.

Ocular cysticercosis. On May 26th, much to our astonishment, the retina had parted and in place of the detachment was an iridescent cysticercus in the vitreous. The following day the bladderlike worm was very active and its movements were most interesting.

It provided us with a clear picture of the true movements and activity of the head and suckers. We discovered that each sucker contained an extensible tubule not mentioned in any descriptions in the textbooks. These tubules were extended and retracted periodically in addition to circular searching movements.

The scolex was hard to locate because the ring of hooklets on the rostellum could not be seen at this stage. This led us to believe it was some species of unarmed Taenia. The hooklets were only discovered by microscopic examination following enucleation. The movements were so active that, although several attempts were made to photograph the Taenia, it could not be kept in proper focus.

Fig. 2 (Swett). The rostellum. The spaces are due to folding in the neck.

Fig. 1 (Swett). The entire cyst. The pseudopodlike structures are due to shrinkage and loss of fluid from the cyst.

On June 1st, the distantly seen scolex was directed down and backward into the vitreous, but on June 2nd infiltration of the cyst was beginning and the inactive Taenia inside the bladder was only indistinctly seen. By June 4th, the scolex was again down in the vitreous and very active. The base of the Taenia was infiltrated and not well seen, and we still could not differentiate the organism.

The increasing infiltration made it progressively harder to see any details, but the aqueous, lens, and cornea were still clear on June 6th. On June 8th, the scolex extended down into the vitreous and was well seen and moving actively.

The continued study of the suckers showed the interesting phenomenon not reported in the literature. The scolex was quad-

rate in shape with four cupped suctorial pockets. The rostellum appeared dome shaped, but the double row of hooklets could not be seen when viewed with an ophthalmoscope.

The four suckers were moderately protuberant and from each, while active, extended a very fine, transparent, 6- or 8-segmented, truncated tubule. As each tubule was extended it acted like a hollow, tubular feeler, moving slightly this way or that, as the scolex moved to and from searching for something to grasp. One or two suckers would seem to thrust out these hollow, segmented open cones, but all four were not observed at any one time. After seeing this phenomenon, however, it is easy to imagine that, with the scolex anchored by the ring of hooklets, all four suckers could be used simultaneously for feeding.

On June 10th the eye was tender and, due to increasing edema of the adnexa and infiltration of the vitreous surrounding the cysticercus, no further details could be seen. The eye was enucleated.

The microphotographs show sections through the scolex demonstrating the double row of hooklets which were at no time visible during our interesting observations and finally proved the cysticercus to be Taenia solium.

Microscopic study. A study of the sections showed that there was slight vascularization near the edge of Bowman's membrane. The trabeculum contained large pigment-filled phagocytes, but Schlemm's canal appeared to be normal. The anterior chamber was of normal depth and the angle was free. The iris and ciliary body appeared to be normal. The choroid showed surprisingly little change except for several localized areas of chorioretinitis with adhesions firmly uniting the choroid and retina.

The retina was separated by a serofibrin-

Fig. 3 (Swett). Rostellum with hooklets and two suckers. The other spaces are due to folding in the neck.

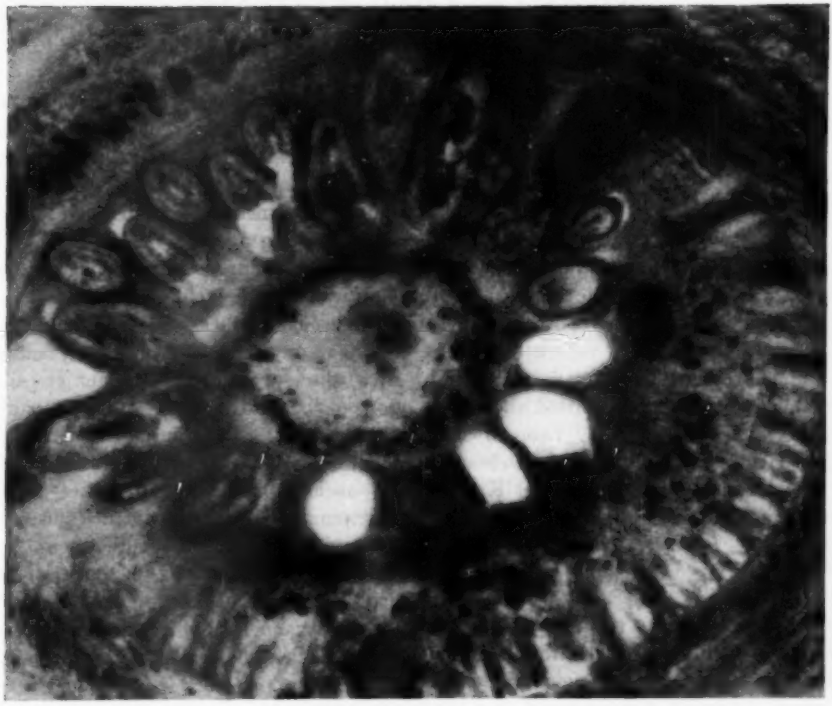

Fig. 4 (Swett). Rostellum with double row of hooklets.

ous fluid that contained many phagocytic cells. The stroma exhibited a diffuse chronic inflammatory process with marked perivascular round-cell infiltration. The stroma showed considerable degeneration throughout, with disintegration of many nuclei and cystic formation in the fiber layers.

The optic nerve showed signs of atrophy with glial replacement of the nerve bundles.

The vitreous at the upper equator near the inner retinal surface showed a cyst of a typical Cysticerus cellulosae. It was enclosed in a space between the vitreous and the retina. Connective-tissue strands were proliferating along the inner vitreous stroma to wall off this space. Sections through the head (scolex) showed four suckers and a rostellum containing a double row of hooklets, large and small.

The cysticercus walls showed no signs of inflammation.

Diagnosis. The diagnosis was Cysticercus cellulosae in the vitreous and chorioretinitis secondary to cysticercus.

Comments

Several visiting doctors from Mexico stated that this condition was fairly common in certain districts in their country and that the loss of an eye was a fairly common complication of Cysticerus cellulosae in the districts where the people indulged in the eating of raw or insufficiently cooked pork.

This patient entered the United States on September 26, 1944, and developed ocular cysticercosis eight months later. As these worms usually develop in about three months, he evidently contracted it in this country, possibly from some infected countryman working in the same section crew.

490 Post Street (2).

SOCIETY PROCEEDINGS

Edited by DONALD J. LYLE, M.D.

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

April 5, 1948

DR. DANIEL KRAVITZ, *president*

This meeting, the annual round-table conference, was devoted to the discussion of "Nonsurgical therapy in ophthalmology." Questions were submitted before the meeting and were divided among the following ophthalmologists, who comprised the panel of experts: Dr. Irving H. Leopold, Dr. Parker Heath, Dr. Ludwig von Sallmann, and Dr. Derrick Vail. Dr. Daniel Kravitz acted as moderator.

MOST DESIRABLE PROPERTIES OF AN OPHTHALMIC DRUG

DR. PARKER HEATH replied that of first importance is effective concentration of the medicament at the suitable point of action. Certain specific characteristics favor the ideal of the proper concentration at the proper point. Some of these characteristics are: the pH range, which should be between 7.0 and 7.6 to avoid dilution of the drug and some stinging and pain sensation from its use. Some drugs actually work better when there is some irritation accompanied by vasodilation, but, in general, any irritation may cause tearing and dilution.

The isotonicity should be within the range of 1.0- to 1.4-percent sodium-chloride solution, the higher percentage being equivalent to the isotonicity of tears, namely 1.32 to 1.427. The isotonicity is usually determined by the freezing point.

The optimum gravity for ophthalmic solutions lies between 1.004 to 1.005. While it is not clearly understood just what part this factor plays, and the range is quite wide, experience has shown the above to be true.

The penetration of some ophthalmic solutions is dependent upon their containing wetting agents. If the substance is to attack the anterior-chamber zone, the medicament should be capable of penetrating the cornea, and this may be aided by a wetting agent, although the medicament must be compatible to the wetting agent.

Another factor besides stability of some significance in ophthalmic drugs is the vehicle used, whether it should be aqueous solution, oily solution, emulsion, ointment, stick, disc, or powder. Another consideration to be had is that of accompanying drugs, such as local anesthesia plus a de congestive; local anesthesia plus an antibio tic, such as penicillin; or other multiple functioning substances or vehicles used with the major desired therapeutic agent.

In aqueous solutions, because of their liability of winking out or passage through the tear channels, multiple dosage is usually employed, or one may put the medicine in an ointment, or, better still, an emulsion which drags it over the cornea with winking. Also, these two vehicles do block the drainage canal and keep the medicament in contact with the cornea longer.

Most of the effective absorption pertaining to the eye is through the cornea, epithelium, and stroma, although there may be considerable absorption through the conjunctiva carried away from the eye by the blood. To avoid further multiple dosage one may use a disc of gelatin or similar substance containing a higher concentration than that obtained in an aqueous solution.

Another principle involved is the use of drugs as teams, which is known as synergism. An example of this would be dilatation of the pupil realized from homatropine plus cocaine. So, the ideal result to be obtained may require multiple medicaments.

Another approach to the use of medicaments is to presensitize the eye by means of heat or by drugs which scuff up the surface of the cornea, such as cocaine, to permit

further penetration through the epithelial barrier. There must also be a balance in the polarity so that the epithelium and the stroma will not prevent the ingress of the substance.

Some substances are effective in mild dosage and destructive or irritative in heavy concentration. The knowledge of the concentration is to be had from experimental studies and samples of the tissue and the aqueous, and noting the effect of the chemical used.

An ideal vehicle for ophthalmic drugs is one which is self-sterilizing to overcome the inevitable contamination from frequent use. This requires a substance, usually one of the benzoic esters, in weak enough concentrations to have no effect on the medicament or produce undue irritation. Another method of avoiding contamination is by the use of individual pipettes for each dose used.

CRITERIA FOR THE USE OF D.F.P.

DR. IRVING LEOPOLD said the interest in the fluorophosphates was stimulated in World War II by information obtained from war prisoners indicating that Germany had prepared quantities of an alkyl derivative of fluorophosphoric acid for possible use as a war gas. It was probably the nerve poison about which rumors were current at the time. Earlier, dimethyl and di-ethyl fluorophosphate had been prepared by Lange and Von Krueger in Germany.

Investigation of the fluorophosphates was initiated in England. A series of alkyl derivatives was prepared and their toxicity to various species of animals studied. A striking feature of their action was an intense, long-lasting constriction of the pupil, and this suggested an action similar to that of physostigmine or cholinesterase. Studies by Mackworth showed this to be the case. Not only was the cholinesterase more sensitive to di-isopropyl fluorophosphate than to physostigmine but the action was more prolonged; indeed it was impossible to obtain any evidence of reversal by the methods effective for physostigmine.

Following the British work, detailed studies were undertaken and carried out in this country through the chemical warfare service, and it is now accepted that the only definite pharmacologic effects of D.F.P. are those related to its inhibitory action on cholinesterase. Thus, the pharmacologic effects of D.F.P. closely resemble those of physostigmine, but the D.F.P. esterase combination is an irreversible one.

Because of these properties of D.F.P., but chiefly because of its great length of action, studies were attempted to evaluate its therapeutic effect in glaucoma. The initial studies, reported in 1946, in glaucoma revealed that this drug could lower intraocular pressure and that its length of action was greater than any previously employed miotic. In addition, these early studies suggested that D.F.P. could be effective in some glaucomatous eyes where other miotics in usually recommended concentrations had failed. The initial report dealt with 56 patients or 78 eyes.

Since the initial report, many ophthalmologists have tried D.F.P. but only a few have reported to date. McDonald confirmed the initial findings in a series of 122 glaucomatous eyes. Lebensohn has also reported favorably. Mare obtained the poorest results, finding that only 1 out of every 6 glaucomatous eyes that could not be controlled with other miotics could be held by D.F.P. four months or longer. Dunphy reported at the College of Physicians in Philadelphia last month that D.F.P. was successful in approximately 1 out of every 3 eyes that failed to respond to other miotics. To date our initial series has been enlarged to over 250 eyes and the period of observation now extends over three years.

Several interesting facts have emerged from this study. D.F.P. does cause some untoward and undesirable effects. The drug produces considerable ciliary spasm, false myopia, and associated ocular pain and brow ache in some patients. A few individuals develop cutaneous sensitivity to the peanut oil vehicle and one patient in this series developed cutaneous sensitivity to D.F.P.

Some eyes show an increase in tension after instillation of D.F.P. This has been observed in narrow-angle glaucoma and in glaucoma secondary to uveitis. One case of retinal detachment in a high myope has been ascribed to this drug but it has not been observed in our series nor has Dr. Dunphy encountered it in his group.

Certain recommendations for the use of D.F.P. can be made from this study. It is effective in mild, early chronic simple glaucoma in concentrations as low as 0.01 percent but best results are obtained with concentrations of 0.025 to 0.1 percent in peanut oil. Mineral oil can be used successfully as a vehicle for eyes sensitized to peanut oil. However, it often allows the D.F.P. to come out of solution and must be watched.

In this study, D.F.P. has been reserved for use in those cases of chronic simple glaucoma which do not respond to pilocarpine in 1- to 6-percent concentrations; to 2-percent pilocarpine combined with 0.5-percent eserine; to 20-percent mecholyl and neostigmine; or to 5-percent or 10-percent furmethide. However, it can be safely employed in mild cases of chronic simple glaucoma that respond to other miotics. Fewer instillations of D.F.P. will be required than with other miotics and the diurnal fluctuations in tension will be reduced because of D.F.P.'s greater length factors.

In narrow-angle glaucoma, it will control tension, but no patient with this type is ever given D.F.P. without observing the initial tension response for at least two hours after instillation. If no rise has occurred, D.F.P. may be continued and the frequency of instillation regulated by daily tension curves. It is usually safe to start with 0.05-percent D.F.P. and, if this lowers the tension but ciliary spasm is very bothersome, it is advisable to drop to 0.025-percent D.F.P. which usually produces less spasm. If 0.05-percent D.F.P. is unsuccessful but has not resulted in rise in tension, 0.1-percent D.F.P. may be tried.

Since the tension rise may be due to the vasodilation produced by D.F.P., it may be advisable to use a vasoconstrictor such as neosynephrin solution or epinephrine bitartrate (2-percent ointment) along with D.F.P., as suggested by the clinical studies of Sugar and the experimental work of von Sallmann.

At present, there is no known reason why, on rare occasions, a case of narrow-angle glaucoma shows a rise in tension and in other eyes with narrow angles, the tension is controlled. So far it has not been correlated with the extent of the synechias.

A number of patients with chronic simple glaucoma have been carried on D.F.P. for 2 to 2½ years, but some have developed a tolerance to D.F.P. after being successfully controlled for many months.

In aphakic glaucoma, D.F.P. in 0.05-percent concentration is the drug of choice provided the aphakic glaucoma is not due to vitreous block, as described by Chandler. Again, the initial treatment should be with 0.05-percent D.F.P. going to higher concentrations if the first proves unsuccessful but does not elevate the tension. It is interesting to note that few aphakic patients are bothered by ciliary spasm. Dr. Leopold said that in his first study he suggested that perhaps intact zonular fibers were required for the production of discomfort. Dunphy recently confirmed the observation and suggested that this might be due to the high concentration of cholinesterase of the exposed vitreous body.

Repeated instillations of 0.1-percent D.F.P. can overcome atropine effects on the pupil. In uveitis, D.F.P. is only used as a last resort. D.F.P. has proved of no value in secondary glaucoma after venous thrombosis. It can be successful in acute glaucoma. D.F.P. should be used prior to eserine but not in the reverse order. Eserine blocks the action of D.F.P., but when eserine is preceded by D.F.P., the resultant effect is greater than either alone.

Value of the intravitreal administration of penicillin

Dr. Ludwig von Sallmann said that

there are two postulates for penicillin therapy which are now generally acknowledged; that is, to start the treatment as early as possible and to obtain at this time a sufficiently high concentration of the antibiotic at the place of the lesion, keeping it there for a sufficient length of time.

It is difficult to observe these rules in infections of the posterior segment of the eye. It takes usually more than 12 hours after an experimental intravitreal infection with pyogenic organisms before alarming signs of the inflammation develop. This is also the case in vitreous infections of man. The phase of logarithmic multiplication of the microörganism in the test tube extends to about 10 hours and, at this time, penicillin is most effective.

Corresponding to the in vitro observation is that of experimental intravitreal infections; they cannot be controlled by any chemotherapy when more than 12 hours have elapsed between infection and treatment. Fortunately, this interval can be extended in human infections of the posterior segment to 24 hours or even longer, as clinical experience shows. The smaller inoculum and the early activation of the cellular defense mechanism are probably the cause of this difference.

The second stumbling block for successful penicillin therapy in such infections is the poor accessibility of the focus in the vitreous. It is true that in rabbits an effective penicillin concentration might be obtained by the subconjunctival administration of the drug in a huge dose or, as Leopold has shown, by combining the retrobulbar injection with subsequent iontophoresis placing the proper pole on the eye. However, the difference in the penetrability of the outer coats of the human eye and those of the rabbit's eye creates a factor of great uncertainty, when this experimental technique is applied to clinical infections.

It is impossible to foretell whether the minimal effective drug level will reach in time the infective focus in an individual case and last sufficiently long, and whether the infective organisms have the high susceptibility to penicillin which would, perhaps, justify this method as a logical approach. In view of these unknowns there remains only one way of handling such infections, and this is the direct injection of crystalline penicillin into the vitreous.

The recommendations of such a treatment depends on the fulfillment of two premises: (1) That the trauma of the injection does not imperil the value of the treatment, and (2) that the preparation has no toxic properties which could endanger the retina, optic nerve, or other structures.

The use of a very fine needle of 27 to 30 gauge and the selection of an area close to the ora serrata for the insertion of the needle reduces the danger of trauma to a minimum. The second prerequisite, that is, lack of toxic action was extensively investigated in the Knapp Laboratory for several brands of commercial penicillin and for the four species of penicillin.

It can be concluded from the table that damage to the retina was absent or minimal when a commercial crystalline penicillin was introduced up to the extremely high dose of 5,000 Oxford units. The pure penicillins, J, F, and X, were also well tolerated, except for small circumscribed lesions, when higher concentrations were used.

On the other hand, penicillin K caused extensive edema and hemorrhages in broad sectors of the retina followed by destruction of the retina. Since penicillin K is undesirable in general, the commercial penicillin now available contains only traces of this species.

A great number of eyes were examined after various time intervals and every globe was sectioned serially and studied thoroughly. On the basis of these data it seems a safe procedure to inject intravitreally one or two thousand units of commercial crystalline penicillin in acute infections of this part of the eye.

This may seem an unnecessarily high dose but the experiments confirm the widely accepted opinion that the minimal threshold

dose is close to the optimal dose and that the latter is not less beneficial than much higher concentrations. That is, in experiments with pneumococci and staphylococci, 10 units were as effective as 500 units. Nevertheless, since a higher dose is not injurious it should be preferred, considering the possibility of a low penicillin sensitivity of the infective organism.

Treatment of herpes zoster ophthalmicus with ocular complications

Dr. Derrick Vail said that the patient with herpes zoster is a very ill individual, suffering severe pain. Bedrest and sedation, therefore, are necessary. Treatment is both general and local. Whole blood (250 to 450 cc.) should be transfused, from a patient who has had herpes zoster within 6 to 18 months.

While there is some dispute as to the value of iodide, Dr. Vail felt that it could do no harm and he also felt that 100 mg. of thiamine chloride intravenously is also valuable. Obstetrical pituitrin (0.5 cc.) repeated within 48 hours, is useful in some cases for the control of pain. Care must be taken, however, not to use this treatment on patients with any cardiac complication.

If the patient is seen early in the disease, X-ray treatment directed at the gasserian ganglion on the affected side is reported to be very beneficial, particularly in so far as pain is concerned. Robert advises 75r., 2 or 3 applications within 2 weeks.

The use of smallpox vaccine and autoserum is of doubtful value in these cases. Perhaps the most valuable single treatment, from a general viewpoint, is the use of convalescent blood as advocated by Gundersen. Fever therapy is not advised.

As far as local treatment is concerned, during the vesicular stage, the lids can be treated with a solution of 0.5-percent aluminum subacetate in the form of continuous compresses. In the pustular stage, constant application of zinc-oxide ointment or the application of calamine carbolic lotion is helpful.

All patients with corneal involvement will show iritis, frequently accompanied by secondary glaucoma. The latter must be looked for in every case. The iritis is treated with atropine, hot compresses, and so on and, if glaucoma ensues, paracentesis of the anterior chamber should be performed, and repeated if necessary. Neosynephrin solution (10 percent) is very useful in this circumstance, and atropine must be continued right along.

If corneal lesions are present, they should be treated with cocainization, sterilization with strong iodine solution which is neutralized with more cocaine. It may be necessary to perform a delimiting keratotomy. For severe ocular pain, retrobulbar injections of 0.5 cc. of novocaine, followed immediately with the injections of 0.5 to 1 cc. of 40-percent ethyl alcohol, is exceedingly efficacious.

Uses of neosynephrin in ophthalmology

Dr. Parker Heath said that clinically it is used as a decongestive, as in mild conjunctivitis, ⅛ of 1-percent solution, or in connection with other drugs ⅛ to 1 percent. To produce a substantial decongestion one may use a 10-percent emulsion or solution.

It may be used as a mydriatic for the purpose of examining the fundus (2.5-percent); freeing adhesions of the iris to the cornea (10-percent); in refraction, especially in presbyopia and myopia in order to obtain objective measurements.

It may be used as an aid to cycloplegia when the iris does not dilate by ordinary means. It may be used to overcome severe myosis in glaucoma where it is used with miotics in concentrations of ⅛ percent on upwards. It may be used to dilate the pupil prior to intraocular surgery. In this it is valuable since it permits early and easy reduction postoperatively by use of a miotic. This drug may be used as a provocative test for glaucoma for determining angle block. It also may be used to supplement a mydriatic when there is sensitivity to the mydriatic used.

A very valuable use of neosynephrin

is in infiltration anesthesia, both for major and minor surgery. Here it has a decongestive, prolonged-action effect, causes slower absorption and is antispasmodic, and, best of all, there are few or no side reactions. The best preparation for this is 1-percent solution, sterile, used in proportion of from 2 to 3 drops to 2 cc. of the anesthesia, in concentrations of 1:3,333 or 1:2,000. Neosynpehrin has also been used in connection with allergy, with cold packs. It has also been of value as a hemodynamic, where it is used in shock dosage, 5 to 10 mg. subcutaneously, or 3 mg. intravenously.

Indications for the use and modes of administration of streptomycin

Dr. Irving Leopold said that in order for streptomycin to be successful, the infectious agent must be susceptible to streptomycin; the drug must reach the infected area in adequate concentration; and the tissue must tolerate the streptomycin.

The common organisms for which streptomycin definitely should be considered are: B. coli, Hemophilus influenza, B. tularensis, B. proteus, B. pyocyaneus, anthrax, and Friedländer's bacillus. The tubercle bacillus may also respond to streptomycin therapy. Of course, many Gram-positive organisms and the gonococcus are responsive to this drug but they also respond to penicillin and for these penicillin should be the first choice. Streptomycin can be used for penicillin-sensitive infections that have not responded to penicillin or in eyes that have developed a sensitivity to penicillin.

Organisms develop resistance to streptomycin quickly. Therefore, it is essential to attack the infection with adequate concentrations early.

Wherever possible the local route of administration of streptomycin should be used in preference to systemic administration. In this way, many of the toxic reactions of streptomycin can be avoided. The most important and commonest toxic reaction encountered with streptomycin therapy has been interference with vestibular function. This is probably due to damage to the central nervous system nuclei of the eighth cranial nerve. The auditory branch of the eighth cranial nerve also may be affected, although this occurs less frequently. Neutropenia or agranulocytosis, renal dysfunction, and generalized skin eruptions can develop from systemic streptomycin. The chief dangers of local administration are local tissue reactions and local allergic dermatitis.

According to experimental penetration studies, streptomycin does not penetrate the normal cornea when applied in drop or ointment form. However, adequate corneal levels can be obtained by corneal baths, iontophoresis, cotton packs, and by use of wetting agents. The concentrations obtained in the cornea are much higher when the corneal surface is ulcerated or the cornea itself inflamed.

Solutions of streptomycin hydrochloride or calcium chloride containing 10,000 to 20,000 micrograms per cc. of distilled water are satisfactory for conjunctival infections. This concentration does not inhibit corneal epithelial regeneration. A schedule of instillation every 30 minutes for 3 hours, then hourly until bedtime, can be employed. The treatment interval at night can be lengthened to every 4 hours, and a 2-hour schedule adopted the next day. An ointment containing 10,000 micrograms per unit of base can be used at night. Treatment should be continued for 48 hours after all signs of infection have cleared. Be on the watch for local cutaneous sensitivity; if it appears, stop the treatment.

Corneal ulcers due to streptomycin sensitive organisms can be treated with cotton packs three times daily containing 20,000 micrograms/cc. at 8-hour intervals, corneal baths with the same strength solution, 3 times daily, or by iontophoresis with 5,000 micrograms/cc.

Iontophoresis should be repeated daily. Drops and/or ointment should be used between treatments. Iontophoresis may employ 2 ma. for 2 minutes with the negative pole on the neck and the positive pole in

the eye electrode. Occasionally, temporary corneal edema may result from such treatment. The same procedures can be used for anterior-segment infections and, in addition, subconjunctival injection of 50,000 micrograms per 0.1 cc. can be made twice daily using upper and lower halves of globe alternately. Direct anterior-chamber injections have been safely made with 50,000 micrograms per 0.1 cc.

When dealing with intraocular infections, it may be advisable to reënforce local therapy with systemic streptomycin. Systemic dosage should be large initially in an effort to obtain intraocular tissue concentrations. Evidence exists that suggests better therapeutic results with antibiotics when high concentrations are obtained for a short time rather than lower levels for a long time. Four grams daily divided into 4 doses at 6-hour intervals may be tried for 4 days then dropping to 2 gm. daily. If no improvement is noted after 14 days of such therapy, it would seem safer to discontinue systemic treatment. The earliest indication of vestibular or auditory disturbances should be sufficient reason for immediate cessation of systemic treatment.

Dr. Leopold said that he had not seen a case of nonspecific anterior uveitis or of anterior uveitis of so-called tuberculous or brucella origin respond to streptomycin therapy by local or systemic administration.

The work of Grignolo in Italy would indicate some beneficial effect of systemic streptomycin on posterior uveitis due to tuberculosis. He used 2 gm. daily intramuscularly in divided doses every 6 hours but, in addition, also employed promin every 3 hours. Experimentally, he was able to inhibit but not prevent the development of tuberculosis of the anterior segment with systemic streptomycin.

Vitreous infections may be treated with direct intravitreal injections of streptomycin hydrochloride for best results. Five hundred micrograms/cc. can be injected safely into the vitreous. Care must be exercised not to touch the lens. Diathermy puncture may be made about the needle puncture. If the ophthalmologist hesitates about using intravitreal streptomycin, he can try therapy with 50,000 to 100,000 micrograms/cc, anterior-chamber injections of streptomycin or he can inject streptomycin retrobulbarly, applying anterior-segment iontophoresis with the negative pole on the eye electrode. One hundred thousand micrograms in 0.22 cc. to 0.5 cc. can be injected retrobulbarly.

Advantages and limitations of iontophoresis with antibiotics

Dr. Ludwig von Sallmann said that the conservative method of iontophoresis is of interest as a means for obtaining relatively high concentrations of the antibiotics in various eye tissues. Corneal iontophoresis serves the purpose well as far as the anterior segment of the eye is concerned. This has been shown convincingly by several investigators. For example, 40 mg. percent of sulfadiazine and 20 units per cc. of penicillin and, according to Leopold, 70 units of streptomycin were measured in the aqueous humor of rabbits after iontophoretic introduction.

It may be mentioned here that the claims of Hamilton-Paterson, frequently cited in the English literature, that penicillin is a poor conductor and not suited for iontophoresis have been completely disproved by several investigators. The drug level persists high for several hours although the peak of the concentration is reached in about one hour and is followed by a moderately steep disappearance curve. The hypothesis that any method which produces high penicillin levels in the aqueous for this length of time is of definite advantage, is strongly supported by results of in vitro experiments with penicillin. It is shown that a drug concentration of 10 units per cc. is bactericidal on 18-hour staphylococci cultures when the latter is exposed to this concentration of the antibiotic for 4 hours; subcultures of the centrifuged sediment were negative; whereas, lower concentrations of penicillin

did not prevent full growth of such subcultures.

The good penetration of penicillin, streptomycin, or sulfonamides into the eye under influence of an electric field with the corneal technique, is almost entirely limited to the anterior chamber, as is the case with other electrolytes. This can be well illustrated by the use of radioactive isotopes (Na 24 and I 131) when one applies a new technique of autoradiography. This method utilizes the photographic action of the radiations emitted from the tracer elements. The autoradiogram depicts the actual distribution of the artificial radio elements in frozen slices of the eye. Sodium is obviously accumulated only in the anterior chamber. It is interesting to see that iodine introduced under the action of an impressed potential is bound predominantly to the structures of the cornea and iris. In aphakic eyes the Na 24 diffuses from the anterior chamber into the vitreous space and here has its beneficial effect.

In a few instances, it was possible to achieve an intense darkening of the film in the area corresponding to the vitreous space of rabbits' eyes with the lens in place. A ring zone between limbus and ora serrata was selected as portal of entry of the current on the eye. However, in other experiments with the same technique the penetration of Na 24 into the vitreous was negligible. Further studies are necessary, therefore, before this technique of iontophoresis can be considered for clinical use.

Another type of iontophoresis (lid iontophoresis) in which the electrode is placed on the closed lid was rather disappointing in numerous experiments. Extracts of the layers of the lids, of conjunctiva, of cornea, and of the aqueous humor of these eyes did not contain much more penicillin or sulfadiazine with the use of the electrical current than with the simple application of wet dressings.

Medical treatment of chronic simple glaucoma

Dr. Derrick Vail said that it is necessary before undertaking medical treatment to classify the case into shallow-chamber or deep-chamber glaucoma. In addition, other factors must be considered. For example, the economic status of the patient, that is to say, whether he is in a position to afford frequent visits for observation of the efficacy of the treatment; whether the distance is too great for frequent trips; whether the patient is intelligent enough to carry out your directions, particularly regarding the technique of instilling the medication; or whether he is likely to prove uncoöperative.

Having decided that a case is suitable for medical treatment, we have at our hand a number of suitable drugs (miotics), the action of each one of which is a little different from the other. It is important to understand these differences in order intelligently to make the best use of the available preparations.

Pilocarpine, for example, acts directly on the iris sphincter fibers, and also has a constricting effect on the iris blood vessels. It, therefore, produces no congestion of the ciliary body, particularly, or of the iris. This is very important, because in the narrow-angle glaucoma, congestion of the ciliary body may increase the shallowness of the angle and make matters worse. D.F.P. has been known to do just this, and a few cases of acute glaucoma have been precipitated by the use of D.F.P.; carcholin (doryl), mecholyl, furmethide, eserine, prostigmine, and D.F.P. all act by destroying the cholinesterase.

As you know, the sphincter of the iris and the ciliary muscle contract by the action of acetylcholine, which is liberated in the ganglion cells and at the myoneural junction of the parasympathetic nerve endings. Acetycholine is constantly being destroyed by cholinesterase (tissue ferment). The formation of too much cholinesterase prevents the normally formed acetylcholine from stimulating the sphincter muscle.

Dr. Leopold has discussed the pharmacology in the action of D.F.P. Dr. Vail said that, in his experience, this drug has been

disappointing. Combining in the same solution, or at the same time, pilocarpine and eserine gives a synergistic action to these drugs, and the effect is enhanced thereby. Similarly, one can combine prostigmine, or D.F.P., with carcholin; 0.75 to 1.5-percent solution of carcholin put into a 1:5,000 zephiran solution is an exceedingly useful drug. A 10-percent solution of mecholyl has been advocated, but it does not, at the moment, seem to be in much favor. A 10-percent solution of furmethide in distilled water is one of the more recent drugs, but it does not seem to be fulfilling our expectations. Furthermore, there is considerable doubt as to its availability.

The weakest solution, or combination of solutions, that will control tension is of great importance. Furthermore, it must not be forgotten that one can use efficiently pilocarpine in solutions that are stronger than 2 percent, even up to 8 percent, without particular injury. Naturally, should the conjunctival sac become sensitive to any of these drugs, it is necessary to switch to another preparation.

Evaluation of the patient as a whole is essential to the treatment of chronic simple glaucoma. It is well known that mental states of imbalance, perturbation, anxiety, grief, fear, rage, irascibility, and so on play a big part in the elevation of intraocular pressure, and attention should be paid to these factors by the physician. The patient's errors of refraction must be corrected and the use of stimulants, such as coffee and tea, should be avoided.

Heat and cold in ophthalmic diseases

Dr. Parker Heath said that the use of heat is considerably overdone, and the benefits of cold are not usually appreciated. In the use of heat, either by compresses or any other of the usual methods, the pleasing sensations that go with it prolong its use unduly and its frequency of application. It is valuable as a means of treatment and an adjunct to drugs, producing vasodilation, if used for a limited time, not over a week, 3 times a day for 10 minutes each time.

The continued and indiscriminate uses of heat causes the skin to soften and the conjunctiva to become edematous. Sometimes the cornea becomes edematous. The whole globe may acquire a chronic congestion from chronic use of heat.

The methods of applying heat are of some consequence so far as its effectiveness is concerned. Hot, moist heat is the conventional method. Infra-ray heat may be used; deep diathermy; pasteurizing with heated metals; and high-frequency heat. All have their special places, special benefits, and particular usage. Just as with the actual cautery, the thermophore and other methods of applying heat should be used as nearly as possible with precision.

Cold, commonly neglected, is very valuable, particularly postsurgically to reduce tension on the sutures by keeping down the edema, to prevent slippage, to reduce pain, and the use of CO_2 snow is very valuable in certain angiomatous lesions of the lid and may be the method of choice. As a decongestive, cold is still very valuable. It may be applied from an ice cake, using moist compresses; it may be applied by a stream of cold air, or by a CO_2 snow pencil.

Present status of the antihistaminic drugs in ophthalmology

Dr. Irving Leopold said that for antihistaminic drugs to be effective in allergic ocular disease, histamine should be released by the allergic condition. This is often a difficult point to prove. Consider the ocular condition of uveitis. This is generally believed to be a manifestation of hypersensitivity. There are anaphylactic and bacterial infections and types of hypersensitivity.

The anaphylactic type is that which results when foreign protein is reintroduced into sensitized tissue. The reaction is characterized by a quick onset after the reintroduction of the foreign protein, by spasmodic contraction of smooth muscle, and by an increase in capillary permeability. This type of

sensitivity can be transferred and is usually accompanied by the presence of specific precipitins in the body fluids.

The bacterial type of hypersensitivity is not characterized by the presence of precipitins in the blood stream and it cannot be passively transferred. It is produced by not only the bacterial bodies but also by soluble bacterial proteins. Bacterial infection type of hypersensitivity is thought to be responsible for the bulk of uveitis. However, the only really suggestive evidence for histamine release is found in the anaphylactic type of reaction. The evidence for the role of histamine in the bacterial type of hypersensitivity is at present very unconvincing. Therefore, if the antihistaminic drugs should have value in uveitis, one would expect to find it in the anaphylactic type of uveitis.

This type of uveitis can be produced experimentally by injecting horse serum into the vitreous and following, 10 days later, with a second injection of horse serum intravenously. A series of rabbits were injected in this manner by Dr. Dean, Dr. Blazar, and Dr. Leopold at the University of Pennsylvania.

One group received intramuscular Pyribenzamine prior to the intoxicating dose of horse serum; another group received Pyribenzamine intramuscularly simultaneously with the intoxicating dose of horse serum; another group received Pyribenzamine 24 hours after the intoxicating dose of horse serum. Subconjunctival injections of a Pyribenzamine solution were made in three groups of rabbits, prior, simultaneously, and after the intravenous dose of horse serum.

The only eyes that were definitely benefited by Pyribenzamine were those that received the drug intramuscularly prior to the intoxicating dose of horse serum. Even repeated intramuscular injections of Pyribenzamine had no significant effect once the uveitis was established.

These preliminary studies indicate that the anaphylactic type of ocular hypersensitivity reaction can be prevented by antihistaminic drugs but cannot be successfully treated once the ophthalmic reaction has been established.

These observations are not very encouraging for uveitis from the therapeutic viewpoint. They possibly may be of some value in suggesting a method of alleviating endophthalmitis phaco-anaphylactica and sympathetic ophthalmia. In both of these instances antihistaminic drugs can be administered prior to the possible onset of the ocular reaction. It may be advisable to give antihistaminic drugs pre- and postoperatively to all cataract extractions, particularly where extracapsular extraction may occur. In ocular injuries, particularly when uveal tract and the lens are injured, it may prove helpful to administer antihistaminic drugs.

In what conditions is bacitracin effective?

Dr. Ludwig von Sallmann said that information on the usefulness of this compound in ocular infections is scarce. Dr. Bellows has reported briefly on the benefits of local bacitracin therapy in superficial infections of the eye. Dr. Braley used bacitracin therapy in 37 cases of conjunctivitis from which mannitol-positive staphylococci could be cultivated. Frequent instillations of a solution, containing 500 units per cc., extended over 24 hours resulted in negative cultures for a limited period of time. Many of the patients seemed to have benefited from the treatment but no conclusive results were obtained.

The comprehensive data on irritation, penetration, and therapeutic effect in experimental intraocular infections are contained in a study by Dr. Locke of the Eye Institute. He found that concentrations of 5,000 units per cc. produced severe inflammatory response of the lids and conjunctiva and of corneal abrasions when instilled frequently or introduced by the galvanic current. Solutions of 1,000 units per cc. were well tolerated.

Miss B. Johnson, the discoverer of bacitracin, measured 10 units per cc. in the aqueous one hour after iontophoresis of a

solution containing 1,000 units per cc. Despite this high drug level in the aqueous, local bacitracin therapy failed to check experimental infections of the anterior segment of the eye produced by several strains of mannitol-positive staphylococci which had exhibited in vitro an average sensitivity to the drug. This is in clear contrast to results obtained with penicillin or streptomycin.

Systemic use has not been studied in eye diseases, nor were investigations carried out on the transfer of the drug from blood to ocular fluids. To be more specific in predictions concerning the value of this antibiotic on the eye, one has to resort to the clinical results in pyogenic infections of the skin and of surgical wounds and also in syphilitic lesions.

Experience of the Departments of Dermatology and Surgery of the Presbyterian Hospital is excellent in clearing up pyogenic skin infections with bacitracin ointment. Similarly good are the results in surgical infections. The data reported by Dr. Eagle on bacitracin treatment of experimental and clinical syphilis are also promising. It remains to be seen whether there exists a true synergism between penicillin and bacitracin on the bacteria which this author suspects are active in spirochetal infections.

Altogether it seems that infections of the lids, of the conjunctiva, and of the cornea could be controlled by bacitracin possibly as effectively as with penicillin or even better when penicillin-resistant strains are involved. Therefore, bacitracin would permit, in such cases, economy in the use of penicillin, or would supplement it. This is no small advantage if one remembers the continuous increase of the number of penicillin-resistant strains and the frequency of allergic reactions to penicillin or streptomycin.

PROPER HANDLING OF OCULAR TUBERCULOSIS

DR. DERRICK VAIL said that once you have determined that you are dealing with ocular tuberculosis in a given case, the type of lesion present will determine the treatment given. The discussion will, therefore, be limited to cases of uveitis and choroiditis suspected of being tuberculous. In the very acute stage, fever therapy offers our best hope. Typhoid vaccine is the favorite agent, but milk-shots and Coley's serum should not be forgotten. The treatment of tuberculous uveitis is exactly similar to that due to any other etiologic agent; atropine, compresses, paracentesis, and so forth are necessary.

Secondary glaucoma is very frequently present, and must be treated adequately. Autohemic therapy has been advised by a number of authors. However, the plan of replacing the aqueous with blood freshly drawn from the patient is a dangerous and futile step.

Ophthalmologists are the only medical practitioners who are still using tuberculin treatment, and the wisdom of this is not too sure except in cases of sclerosing keratitis, where the response of the lesion to the treatment is sometimes very dramatic. Various forms of tuberculin have been used, but the trend now is to use old tuberculin, and to give the treatment according to the methods described in the various books of ocular therapeutics, beginning, of course, with an exceedingly small dose on patients who show marked skin sensitivity.

It is questionable whether the Mantoux test gives much information that will help in deciding whether a case is tuberculous or not, since it is the experience of most that pathologically proved cases of ocular tuberculosis can be demonstrated in patients who have a negative Mantoux test.

If tuberculin treatment is used, it should be given for a sufficient length of time, often as long as two years, in order to desensitize the patient's skin to the tuberculin. The use of the ultraviolet light treatment locally is no longer advocated, and general treatment with ultraviolet is grossly overrated. Streptomycin and promozol, currently being studied by Dr. Alan C. Woods and the Wilmer Institute group in the treatment of

experimental tuberculosis, offer much more hope for the treatment of human cases.

Medical management of corneal dystrophies

Dr. Parker Heath said that if one means by corneal dystrophy a local alteration in the metabolism or a local effect from alteration in the metabolism of the body in general, the treatment is apt to be quite different from that for a degenerative process. The so-called corneal degenerations are often not degenerations at all, but active inflammatory lesions, sometimes with minor incidental degenerative changes.

An example of this is lipid interstitial keratitis, which is a storage infiltration disease; a storage of lipids sometimes actively mobilized by cells or by the blood stream or both. The corneal leukomas may follow an overproliferation and repair from a minor primary lesion.

Those lesions requiring purely medical treatment, apart from surgical or mechanical, are certain epithelial and endothelial dystrophies; some forms of band keratitis, wherein the calcium metabolism may be an important factor in the cause; the groups of interstitial keratitis; certain dystrophies associated with the aging process; the so-called neurotrophic group; lesions associated with deficiencies in diet, particularly vitamin A; and the hereditary dystrophies.

For the most part, the best treatment is preventive. It may be palliative, especially if the initial lesion is apparently minor, as a herpes simplex or an abrasion from a cilia or a minute foreign body. In the first instance, the treatment is to eliminate the herpes by pasteurization with heat. In the second instance, the treatment is to remove the foreign body or the lash.

From some minor lesions in a patient who is predisposed there spread across the cornea marked alterations in nutrition with a deposit of foreign material such as fat, calcium, and a proliferation of unwanted fibroblasts. The treatment for the overstorage of fat, by histiocytes or local depots of fat in the cornea, is to put the eye in a state of rest. If uveitis is active, treatment should include the use of atropine or scopolamine, a program of moderate, daily, and sustained exercise, sweats, and thyroid if at all indicated because of low metabolic levels. The use of iodides is indicated from the standpoint of history in therapeutics, and in some cases there is apparently an improvement following their use.

Those dystrophies of endothelium, which produce islands of altered epithelium and some desquamation and staining areas and give the cornea a greasy look in a maplike pattern, ordinarily have a poor prognosis. But the endothelium under certain circumstances, given sufficient time, does regenerate or repair and the bullae subside.

The best local treatment for the bullae is a series of multiple punctures with the actual cautery pushed partly into the stroma, provided it is not in the pupillary zone, and the use of an iodine ointment. Pad the eye to decrease the mechanical irritation and the destructive effect of the upper lid and use a cycloplegic or miotic as indicated.

Scrubbing the epithelium off and applying iodine in these cases may be done once, but often it does not help. The treatment as outlined is much more effective if one has the patience to stay with it.

The nutrition of the cornea is seriously affected, in some instances, by the overgrowth or the ingrowth of blood vessels. When these blood vessels can be reached without too much destruction, it is advisable to scarify or cauterize them.

Those endothelial diseases which produce the aforementioned epithelial changes require treatment over a period of months, sometimes up to two years. Such patients may, with proper treatment, be able to keep their eyes and have a modicum of vision or light perception.

In passing one might mention that some corneal lesions in the dystrophy group, especially with secondary implantation of cal-

cium and fibrous scarring, are best treated by lamellar implants, or through-and-through implant, or simply by partial keratectomy.

Use of furmethide in glaucoma

Dr. Irving Leopold said that clinical investigations with furmethide found it to be more effective in the late stages of acute glaucoma but less effective in the early stages than mecholyl (20 percent) and neostigmine (5 percent). In secondary glaucoma furmethide was found to be about as effective as mecholyl prostigmine. Furmethide has no influence on glaucoma secondary to venous thrombosis. In chronic simple glaucoma, 10-percent furmethide was slightly superior to a 2-percent pilocarpine solution when instilled 3 to 6 times daily.

Furmethide is apparently nonirritating and no cases of sensitivity have been reported. However, it may produce hyperemia of the conjunctival vessels and also narrowing of the anterior chamber. Cases have been reported of moderate perspiration, salivation, and lacrimation after 1 or 2 instillations of the drug. It is certainly an effective miotic. The chief usefulness would seem to be as a substitute for pilocarpine when the individual eye becomes sensitive to pilocarpine.

It can be tried in acute glaucoma in eyes that are sensitive to mecholyl and neostigmine or in which these drugs have not been successful. In chronic simple glaucoma, the drug must be instilled frequently at least 3 to 6 times daily in most cases.

Many patients complain about its taste and, on one occasion, it produced profuse sweating, diarrhea, and almost collapse in a 170-pound man when applied 6 times in 2 hours in an eye with acute glaucoma.

In 20 eyes that have failed to respond to 3-percent pilocarpine, only one showed benefit on subsequent use of furmethide (10 percent) and this was only temporary.

Pilocarpine will continue to be the miotic of choice for most cases of simple glaucoma. It produces few untoward symptoms such as ciliary spasm, false myopia, or brow ache. It is successful in many cases and has stood the test of time. If low concentrations fail, higher ones can be tried.

Many ophthalmologists feel that any case of chronic simple glaucoma that loses field under pilocarpine therapy should be operated. If stronger drugs are tried with greater effect on the sphincter and ciliary muscles and on the ocular vessels, the patient may suffer undesirable symptoms. But all patients vary in their tolerance to drugs and one cannot always predict which patient will be bothered. Very little will be lost by a short trial period on more potent miotics.

Also, there are cases of patients with one eye in whom the first eye was lost through surgery, patients who refuse surgery, patients in whom operative procedures are inadvisable because of health and age, patients in whom previous surgery has failed, and patients whose tension must be maintained until surgery can be performed.

Even the most ardent supporters of early surgery in glaucoma will, at times, try the stronger miotics. In such cases the newer miotics may prove helpful.

Sulfonamides as the drug of choice

Dr. Ludwig von Sallmann said that from an ophthalmic point of view Bacillus pyocyaneus is the most important member of the group resistant to penicillin but often susceptible to sulfonamides. Its sensitivity to the latter, as well as to streptomycin and bacitracin, varies from strain to strain, which would explain the contradictory reports in the literature. A similar situation may also be encountered in virulent infections belonging to the psittacosis-lymphogranuloma group. The work of Thygeson, Braley, Lindner, and the majority of other investigators provided evidence for the usefulness of sulfonamide therapy in trachoma and inclusion conjunctivitis. To date it has not been proved that penicillin or any other antibiotic surpasses the effect of sulfonamides in trachoma.

Attention must be paid to the properties of the lesion in the treatment of infections for which several suitable drugs are at our disposal. It was recognized at the beginning of sulfonamide therapy that accumulation of products of protein degradation and heavy infections with a paramount number of microörganisms in the lesion either inhibit or influence adversely the action of sulfonamides. However, startling results of sulfonamide therapy were obtained even in purulent intraocular infections with injury of the lens.

On the other hand, there is overwhelming proof that penicillin and also streptomycin therapy is by far more effective in experimental acute intraocular infections induced by the common pyogenic cocci. On the basis of such conclusive experimental data, penicillin or a mixture of penicillin and streptomycin should be selected as the most promising therapeutic weapon.

In chronic and subacute staphylococcic infections of the lid border, conjunctiva, and cornea, Thygeson, Braley, and others describe satisfactory results with sulfonamides. Here in prolonged use, penicillin and streptomycin, although potentially effective, may sensitize the patient to mold products, may elicit allergic reactions, or may render certain bacterial strains drug resistant for many years to come. These disadvantages outweigh a possibly immediate beneficial result. The same criteria applied to sulfonamides lose their sting because the latter are bound to play a less decisive part in emergency therapy of severe infections.

The compatibility of simultaneous systemic or local therapy with some sulfonamides and penicillin or streptomycin has been established for years. Recently Locke found that bacitracin is compatible with some sulfonamides. All this opens a wide field for the use of antibiotic mixtures containing sulfonamides but the question of true synergism between members of the different groups has not yet been settled. Experimental and clinical experience has failed so far to show any preëminence of such combined treatment in infections of the eye.

Vasodilators in the Treatment of Retrobulbar Neuritis

Dr. Derrick Vail said that there is reason to believe that vasospasm plays considerable part in the eventual injury to the optic-nerve fibers in this mysterious condition. Therefore, any measures that can be taken to dilate the vessels and improve the nutrition seems to be a logical way of beginning to solve the problem. The use of vasodilators has hastened the recovery of useful vision in many patients with retrobulbar neuritis.

There are a number of agents available. Nitroglycerine (1/100 gr.), nicotinic acid (50 mg., 3 times daily), sodium nitrite (1 gr., daily), 10-percent sodium nitrite intravenously (1 cc.), papaverine (1 gr., twice daily), erythrol tetranitrate (¼ to ½ gr., 3 times daily), and typhoid vaccine intravenously are the vasodilators most commonly used.

Of these, typhoid vaccine, as a fever-inducing agent, seems to be the most valuable. Ophthalmologists would be handicapped in the treatment of many inflammatory conditions of the eye and optic nerve without the benefit of typhoid vaccine.

While dicumarol cannot be classified as a vasodilator, its recent use in the treatment of multiple sclerosis by Putman offers new hope in the treatment of that disease, particularly. If 300 mg. of this drug is given daily, it is necessary to check the prothrombin time frequently and, therefore, the treatment had best be carried out in the hospital.

The startling improvement in the vision of a patient suffering from acute retrobulbar optic neuritis that so often follows the opening of the sinuses, particularly the sphenoid, is convincing proof of the value of vasodilators in the treatment of retrobulbar optic neuritis.

Bernard Kronenberg,
Recording Secretary.

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THE MOTOR VEHICLE DRIVER

A driver's license is now mandatory throughout the Union, although Kansas, Missouri, and South Dakota require no examination, visual or otherwise. The latest survey of state requirements for motor vehicle operators—annually published by the American Optical Company—still shows a lamentable diversity in almost every item, although voluntary uniformity is gaining ground as already evidenced by the increasing similarity in signals, signs, and road markers. The eligible age for acquiring a driver's license varies from 18 years in New York, Pennsylvania, and Vermont to 14 years in North Dakota, New Mexico, and South Carolina.

The requirement for corrected visual acuity is 20/20 in South Carolina; 20/60 in Illinois, Nevada, and West Virginia; and 20/70 in Massachusetts and Maryland. The one-eyed driver is accepted everywhere if his seeing eye has a full field and a corrected acuity of 20/20 (Texas, Alabama) to 20/70 (Massachusetts). No state yet tests for night vision or glare resistance. In several states drivers are restricted to daylight hours if their deficient acuity is not adequately cor-

rectible, but the discriminatory level varies from 20/100 in Maryland to 20/70 in Oregon and 20/50 in Pennsylvania.

The total of drivers now licensed in the United States reaches 50 million. Six million are examined annually. Reëxamination for renewal is required only in Colorado, Iowa, and North Carolina. Visual screening tests that will gain official approval must be performed rapidly, with relatively simple and inexpensive apparatus, by lay personnel of limited training. In some states (Minnesota, Florida, and California) the applicant who fails is given a record blank and referred for further investigation to a "visual specialist" (ophthalmologist or optometrist) of his own choice. In Florida, where 20/50 acuity is passing, 15,000 of the 200,000 applicants for driver's license in 1947 were referred for visual examination. Eventually the visual tests for drivers should be as significant for the adult population as the screeening tests in schools are for children.

The Driving Research Laboratory of Iowa State College states that 60 percent of the general adult population require glasses, but only 30 percent are using them, and, of the glasses worn, 30 percent were no longer correct at the time of examination. Uncorrectible poor vision is present in 5 percent. Of 889 truck drivers checked by the U.S. Public Health Service in 1941, only 45 percent had 20/20 acuity in each eye, but just 8 percent were wearing glasses.

The American Association of Motor Vehicle Administrators recommends that the driver's license of those requiring glasses be stamped: "Must wear *corrective* glasses while driving." The word "corrective" is stressed because, otherwise, plain or sunglasses would technically meet the requirement.

Education should emphasize the trifling disadvantages of glasses compared to the signal importance of reading signs and markers easily and quickly. The average stopping distance on dry pavement for a car at 60 miles per hour is about 200 feet, and the average traffic sign can be read at 225 feet if the visual acuity is 20/20. With lesser acuity this distance is, however, reduced proportionately. The reading of signs stimulates both the attention and the visual outlook. A driver is able to perceive an unexpected obstacle only half as far away as he can see an expected one. The National Safety Council would require that glasses be worn, if binocular vision is less than 20/40; but in monocular vision 20/30 is the suggested minimum.

In the past two years America has had the lowest annual mileage death rate in its history but motor vehicle accidents still rate tenth among the leading causes of death. In 1947, the total of traffic deaths in the nation was 32,000, averaging 8.6 deaths per 100 million miles of travel, being about twice as heavy in the rural areas as in the cities. One fifth of the road accidents involved children, being highest in the age group of 5 to 6 years. The lowest mileage death rates—4.3 and 4.7 per 100 million miles, respectively— were reported in Connecticut and Rhode Island. In both states the minimum acceptable acuity is 20/40.

More important for traffic safety than skillful driving and adequate visual capacity is a sense of social responsibility. Greater pride should be taken in being a safe driver than a fast one. The 16-to-20-years age group is involved in five times as many accidents as those aged between 45 and 50 years. Although it is known that 15 percent of the drivers are responsible for 90 percent of accidents, the factors responsible for accident proneness still require critical evaluation. Deficiencies in dark adaptation, field of vision, eye-hand and eye-foot coördination are all more significant than central visual acuity. The macular vision of accident-prone drivers does not differ from that of the average driver. Many drivers with only 20/200 vision have had no accidents in 20 years of driving. Since most hazards are very large, the perception of contrast is probably of more value than simple acuity.

The American Association of Motor Vehicle Administrators feels that most drivers with substandard vision can be allowed the privilege of doing the kind of driving they are able to do in reasonable safety; and hence, they should be restricted to daylight hours, limited speed, or a certain class of roads.

Rarely is a person so color blind that he cannot distinguish between red and green traffic lights. Besides the brightness difference, the standard position from above down of red, yellow, and green is an additional clue that allows most drivers to overcome their color deficiency. The "red and green" traffic lights are usually yellow-red and blue-green and these yellow and blue components also aid differentiation. In fact the color blind are less confused by the red and green lights than by the red and amber.

To the ophthalmic specialty belongs the task of determining the amount and quality of vision needed to be a safe driver and to improve, simplify, and standardize the screening tests required. For the rating of visual acuity, standardized illumination should be provided, and an unlearnable letter chart, as has been used in the U. S. Navy, is probably more suitable and effective than the Snellen refraction chart now in vogue. Visual field tests may be restricted for the sake of time to the horizontal meridian since that is the angle most important in driving. Simplified tests for night vision and glare resistance are urgently needed.

James E. Lebensohn.

A RUMANIAN EYE JOURNAL

Apart from Norway and Sweden, the European countries bordering on Russia occupy at present a somewhat uncertain position in relation to the civilization of western Europe. The results of the two great world wars have, on the one hand, given them great changes in area and population, and, on the other hand, have made more manifest than ever their natural commercial and cultural ties with Russia, whose communistic ideologies are playing an enormous part in organization and development of these border areas. Yet the latter display strong nationalistic tendencies in which it seems inevitable that western civilization will ultimately have a powerful influence.

Rumania is an especially interesting illustration of these competing influences, with a language distinctly Roman in structure although extensively Slavic in vocabulary, and a people whose originally Slavic dominance was early modified by Roman military colonization. The religion of its people is mainly Greek orthodoxy; its most widely used channel of linguistic contact with the outside world is still the French tongue. In that idiom the reports of Rumanian medical gatherings are most likely to reach the scientific reader of other countries.

Prominent in ophthalmology for very many years has been Nicholas Blatt, active in moves toward improved clinical resources and for the control of blindness. From time to time Blatt's contributions to the literature of ophthalmology reach the United States. Now comes a further example of his enterprise in the form of the first Rumanian journal entirely devoted to ophthalmology, the *Revista de Oftalmologie*.

On the editorial board of the new journal, the name of Blatt (Nicolae Blatt in Rumanian), as director, is associated with Filatof (Russia), Bailliart and Jeandelize (France), Bietti (Italy), Busacca (Brazil), Cosmettatos (Greece), Franceschetti (Switzerland), Igersheimer (U. S. A.), Pascheff (Bulgaria), Duke-Elder (Great Britain), and Weve (Holland). The editorial secretaries are Virgil Popovici, Nicolae Zolog, and Ion Moisescu.

Issue number one of the new journal, dated July to September, 1948, carries 172 pages of original articles, including six papers in French, four in Rumanian, and two in English. The Revista is the official

organ of the Rumanian Ophthalmological Society.

W. H. Crisp.

OBITUARIES

JOHN ELMER WEEKS
(1853-1949)

After a short illness, Dr. John Elmer Weeks died on February 2nd at La Jolla, California, where he was spending the winter. Thus ended a long and illustrious career for he was born on August 9, 1853, in Painesville, Ohio. He was the son of Seth R. and Deborah Ann (Blyenburgh) Weeks. In 1881, he received his medical degree from the University of Michigan. He then came to New York for an internship in the Alms House and Workhouse Hospital on Welfare Island.

Learning of his capabilities, Dr. Herman Knapp invited him to become associated with the Ophthalmic and Aural Institute. He first served it as a clinical assistant in 1882, but, in 1884, he interrupted his studies there to take a year of postgraduate work at the University of Berlin. He returned to the Institute in 1885 as resident physician and in 1887 became an assistant surgeon. He labored long and hard under the tutelage of Dr. Knapp whose stimulating influence sparked the natural ambitions of his apt pupil.

Dr. Weeks' great desire for knowledge and intense interest in research led him to investigate the bacteriology of acute epidemic conjunctivitis. In 1886, out of these studies came his epoch-making report identifying the organism which bears the name of Koch-Weeks bacillus as the causative agent. While this discovery was acclaimed far and wide, he accepted the honors with characteristic modesty and merely went on his way.

He served as chief of clinic, Vanderbilt Clinic, College of Physicians and Surgeons, in 1888, and continued his association with Dr. Knapp until 1890, when he resigned to accept a surgeonship at the New York Eye and Ear Infirmary—a position he continued to hold until his retirement in 1920. At that time he was made a consulting surgeon. This institution soon became his absorbing interest and he devoted much time to its clinics and its pathologic laboratory. Here he found ample opportunity to develop his natural surgical ability to that degree of perfection he attained. Not only was he a most adept surgeon, but also a diagnostician of great ability.

Coupling these achievements with a sound knowledge of bacteriology and pathology it is no wonder that he held many responsible positions and achieved great fame. Among his teaching assignments were:

Lecturer in ophthalmology, Bellevue Hospital Medical College, 1890-92

Professor ophthalmology and otology, Woman's Infirmary Medical College, 1892-99

Professor of ophthalmology, University and Bellevue Medical College, (which became New York University in 1921), 1892-1921

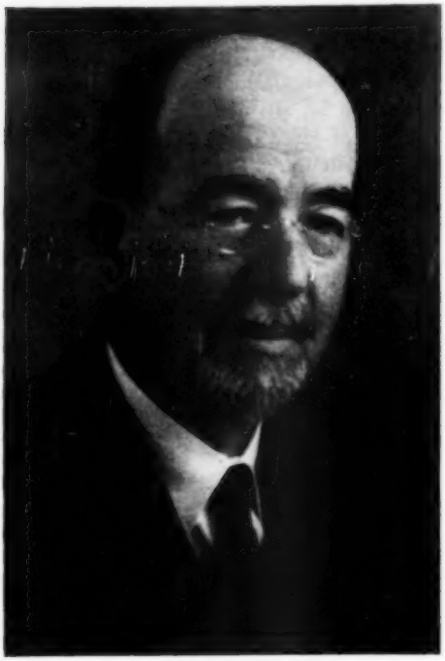
Emeritus professor since 1921

Honorary professor of ophthalmology, University of Oregon Medical School, since 1940

During his active professional life his entire efforts were devoted to ophthalmology. He worked assiduously on the many problems in his specialty. He was one of the founders and early members of the American Board of Ophthalmology.

However, he did not allow his large private practice to usurp all his energies for he travelled much—always in search of new methods and new ideas. He attended medical meetings both at home and abroad, giving as well as receiving instruction. His presentations were largely of a practical nature with a natural emphasis on the surgical aspect. His method of reconstructing an orbital socket, which he presented in 1904 before

the International Congress of Ophthalmology, won him wide acclaim. His writings on the surgical treatment of such conditions as cataract and glaucoma did much to earn for him his well-deserved reputation as an outstanding ophthalmic surgeon. His manual dexterity along with his gentle handling of tissues caused many ophthalmologists to be eager to observe the master at work. One of his favorite surgical procedures was the Lagrange operation, at which he was at his best.



JOHN ELMER WEEKS

As an author, he produced, in addition to his many articles on all phases of ophthalmology, two textbooks. His first was published in 1892, *Diseases of the Eye, Ear, Nose and Throat, A Manual for Students and Practitioners*, and then, in 1910, his *Diseases of the Eye*. This latter volume added greatly to his reputation for it was widely read and remained for many years one of the standard textbooks in ophthalmology.

Naturally, along with such achievements came many honors. He was chairman of the Section on Ophthalmology of the American Medical Association in 1902, at the same time holding the chairmanship of the Section of Ophthalmology at the New York Academy of Medicine. In 1910, he was president of the New York County Medical Society; he was president of the American Ophthalmological Society in 1921, and the recipient of the Ophthalmic Research Medal given by the Section of Ophthalmology of the American Medical Association in 1929. He held honorary degrees from three institutions. In 1912 the University of Michigan, his alma mater, awarded him the degree of Doctor of Science; in 1923, the New York University recognized his achievements with the degree of Doctor of Laws; and, in 1940, the University of Oregon honored him with a Doctor of Science degree.

In addition to the societies already mentioned, Dr. Weeks was a member of the Hospital Graduates Club of New York, the New York Ophthalmological Society (president, in 1912), Pacific Coast Oto-ophthalmological Society, Association for Research in Ophthalmology, Ophthalmological Society of the United Kingdom, American College of Surgeons, and the Canadian Medical Association. He also held honorary membership in the Medical Society of Budapest, the Royal Hungarian Medical Society, the Chicago Ophthalmological Society, and the Portland Oregon Academy of Medicine.

On April 29, 1890, he was married to Jennie Post Parker, a union of which there was one daughter, Eveline Weeks Mount; both wife and daughter survive him. In his wife, Dr. Weeks found an ideal work mate. She accompanied him on most of his journeys and her gracious charm did much to make them a most sought-after couple. Her efforts were untiring and she devoted all her energies to love and care of him. His interests were hers and to her belongs no little share of his preëminence. Her implicit faith in his ability undoubtedly did much to bring out the best that was in this modest, retiring man.

Upon his retirement from active practice in 1924, he moved to Portland, Oregon, to be near his daughter and grandchildren. Here he rapidly assumed an important place in the medical life of that city. For several years he devoted one morning a week to consultations and surgery, but a great part of his time was spent at the University of Oregon Medical School. Recognizing their need of an adequate library he donated the funds for such a building. He counselled the department of ophthalmology and supported much of their research program. His interest in the progress of ophthalmology never waned for, even in the last few years of his life, he was a regular attendant at all lectures sponsored by that department. His presence and sage advice were a great stimulus and help to Dr. Kenneth Swan in the rebuilding of the department of ophthalmology at the University of Oregon.

In spite of the fullness of his professional life, Dr. Weeks found time to pursue his favorite recreations—golfing and fishing. His ability as a fisherman was only matched by that of his wife for the two rarely returned from such an expedition without having established some new records—either for size or for number of fish caught. He loved travel for travel's sake and fortunately lived to enjoy these pleasures he had so justly earned.

In manner, Dr. Weeks was shy, modest, and retiring, at times even appearing cold to the new acquaintance, but underneath this veneer, to those who knew him well, he was a man of sterling character. He was straightforward, honest, and unpretentious. His ideas were of the highest and his heart of the warmest so his passing has created a void in the hearts of his many friends. To American ophthalmology his death means the loss of one of its most illustrious sons. His life will serve as an inspiration and guide to future generations, for what more can one mortal do than to exemplify so completely the value of diligent application, honesty, and modesty. Success and fame were rightly his but the heritage of our specialty has been greatly enriched by the acts and deeds of this noble man.

John H. Dunnington.

HUNTER HOLMES McGUIRE
(1873-1949)

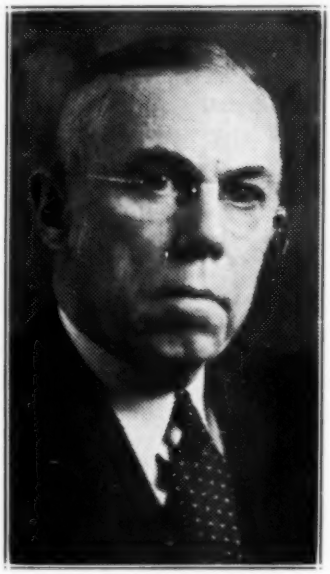
To most it is given to know intimately not more than half a dozen of his fellow men and fortunate is he who can choose these wisely. These few friends may color one's life as much as anything in that life. To those who were fortunate enough to be able to include Hunter McGuire among their intimates, a great richness was added. Quiet, unassuming, he was a physician almost by heredity as he followed in the footsteps of a father and a grandfather. Not to belittle his nobility and professional stature in the least, his outstanding characteristics seemed to be gentleness and kindliness. He radiated culture and hospitality, as might have been expected of a Virginian, scion of such a distinguished family.

His grandfather, Dr. Hugh Holmes McGuire, was a general surgeon who is said to have performed the first cataract operation in Virginia. He founded the first medical school in that state, in 1829, the Winchester Medical College. Another notable relative was an uncle who was medical director of the Army of Northern Virginia and physician to Gen. Stonewall Jackson.

Dr. Hunter McGuire was born in Winchester, March 30, 1873, and died in his sleep at his home in that city of a coronary occlusion on January 22, 1949. He was badly crippled by an attack of poliomyelitis at the age of two years and throughout his life was handicapped in getting about, but this never affected his disposition or his career. On the contrary, it must have developed a compensation in his understanding and sympathizing with the troubles of others. Never did it occasion self-pity, but enhanced a great courage.

It has been said that to learn to know a man one must turn to his writings. Dr.

McGuire has told something of himself in an address entitled "Forty-eight Years' Experience in Ophthalmology." We learn that, as premedical training after graduation from the University College of Medicine, Richmond, Virginia, in 1897, he spent a year in a local drugstore learning the practical side



HUNTER HOLMES MCGUIRE

of drug dispensing and that there he discovered the evil of unrestricted sales of narcotics to the many addicts who were unprotected by the Harrison Anti-Narcotic Law enacted later.

In those days the medical course was only of three years' duration and, after completion of this, he went to Johns Hopkins for the study of eye diseases under Dr. Samuel Theobald, who was then professor and head of the Department of Ophthalmology at The Johns Hopkins Medical School, and Dr. Russell Murdock. He worked in the then small clinics at Johns Hopkins and the Baltimore Eye, Ear and Throat Hospital.

After one year in Baltimore, he returned to Winchester to start practicing. It was customary in those days in Virginia, and in the South in general, to combine the practice of ophthalmology and otolaryngology. And this Dr. McGuire did, although he never cared for the latter specialty and after many years confined his practice to the former.

Dr. McGuire's account of the early days of his practice recalls the days of the "Horse and Buggy" doctor. Operations were usually in the home of the patient and with inadequate anesthesia and assistants. Safety measures, now almost universally practiced, had not yet been discovered so it is a mystery how results were good enough to encourage the surgeon to persist.

As Dr. McGuire states, he had not been long in practice before he realized that his training had not been sufficient to satisfy him. So, he made a decision that undoubtedly was responsible to no small degree for making him the outstanding ophthalmologist that he became. This was to spend a considerable time each year in the ophthalmological centers of America. He studied for three autumns in New York City at the old New York Eye and Ear Infirmary. Immediately thereafter, the Winchester Memorial Hospital was founded by him and others. He was appointed the first president where his duties included being director, bookkeeper, manager, collector of accounts receivable, and distributor of funds. When these ran low, it was his task to solicit more. For 15 years he had to close his office at one o'clock in the afternoon and spend the remainder of the day in hospital duties.

It was only after these years that he was able to go regularly to Philadelphia where he was fortunate enough to attract the interest of Dr. George de Schweinitz, perhaps America's foremost ophthalmologist. Dr. McGuire was captivated by the charm of de Schweinitz and greatly impressed by his learning and ability to teach and to stimulate young men to think. With two others, Thomas Holloway and Emory Hill, a foursome began that was to remain in close

association until death claimed one after the other.

Hunter McGuire was married twice, the first time to Charlotte Claybrook of Westmoreland County, Virginia, and of this marriage there are three children surviving, William P. McGuire, who is carrying on the ophthalmic tradition, Mrs. Julian Broster Lindsey of Alexandria, and Mrs. Thomas Macaulay Booth of London, England. He is also survived by his second wife who was the former Miss Jane Love of Waynesville, North Carolina.

Of Dr. McGuire's many honors, there are a few that must be mentioned. He was a member of the American Ophthalmological Society from 1918 until his death. He was in the council from 1927 to 1931 and president in 1943. He served as first vice-president of the American Academy of Ophthalmology and Otolaryngology in 1924, was co-founder and first president of the Virginia Society of Ophthalmology and Otolaryngology, member of the Southern Medical Association, the College of Physicians of Philadelphia, the American Association for Research in Ophthalmology, the Ophthalmological Society of the United Kingdom, the Pan-American Association for Ophthalmology, and a Fellow of the American College of Surgeons. He was certified by the American Board of Ophthalmology in 1920.

On the skeleton of the bare facts of a man's life, his writings, his photograph, how poorly we do depict the man. Most of these are soon forgotten; even the memory of the dear face grows dim, but what never fades is the warmth, the spirit, the affection the man has imparted and this was kindled in large measure in all who knew Hunter McGuire. A man's physical accomplishments in his brief three score years and ten are few indeed. His most important contribution is his effect on the people whom he contacts during his lifetime. The influences that he has for good or evil are incalculable. As a stone dropped into a calm pool sends ripples to the far shores, so does a man spread his personality. But the simile fails in that the ripples are soon lost; whereas, the good influence lives on and on in the lives of others, and so it is with Hunter McGuire. Those who knew him are better and happier because of this and will, through the years, pass on to others something of his spirit.

Lawrence T. Post.

CORRESPONDENCE

Refractive treatment of asthenopia

Editor,
American Journal of Ophthalmology:

I would like to comment that Dr. Paul W. Miles's article, "Refractive treatment of asthenopia," contained many important pointers on treatment. He states that "correction of phoria by use of horizontal prisms is not very successful." I have had several patients who were treated by other physicians, with horizontal prisms, and little benefit. On phoria testing, I found that there was a vertical component which had not been appreciated. Correction of the vertical phoria by prisms in these cases was usually sufficient for symptomatic relief.

The use of the lensometer for the measurement of the pupillary decentration of old glasses is a very important part of any examination. It will usually explain difficulties and asthenopias that seem baffling.

In going over my records for the past two years, I have 57 cases of vertical prism prescriptions, which were successfully used in correction of asthenopia. Four of these cases had previously required base-out prisms in their correction. Of these, three were satisfied by use of vertical prisms, up to one prism diopter. Up to six prism diopters of vertical prism correction was prescribed with easy acceptance. These were particularly useful in correction of "headaches," "blurring of vision," "head tilting," and "burning." These symptoms occurred in hyperopes, myopes, and cases with astigmatism. In myopes with anisometropia, a vertical prism component was found in

many cases, and was particularly useful in correcting "blurring of vision" at the near point.

The Maddox-rod test with Risley prism was used in testing, but the important factor, before prescribing, was to have the patient wear the correction with prism in a trial frame for a sufficiently long period of time, in the office, in order to determine what portion of the correction found would be accepted. This varied from 25 percent up to 100 percent of the imbalance found on testing. Where there was a difference between the correction for distance and near, less was prescribed, since relief would be obtained even by prescribing only a portion of the prism correction. In three cases, patients returned for reëxamination in one year, and a greater percentage of the correction was then acceptable.

Refraction comprises the majority of work, particularly during the early years of practice. In residency training, the emphasis on surgery is the primary interest of the resident, but a great deal of his success or failure will depend on how much he learns about the tedious "uninteresting" portion of his training, the refraction clinic. Dr. Miles's article is especially valuable to the student, and worth a lot of thought for the practitioner.

(Signed) Maurice Kadin,
Racine, Wisconsin

BOOK REVIEWS

Diseases of the Fundus Oculi with Atlas. By Adalbert Fuchs, M.D. Translated by Erich Pressburger, M.D. Edited by Abraham Schlossman, M.D. Philadelphia, The Blakiston Company, 1949. Edition limited to 995 numbered copies. 337 pages, 81 figures, 44 color plates, index. Price, $30.00.

In 1943 the original (German) edition of this superb book appeared, published by Franz Deuticke of Vienna. It was only shortly after the war that it became available to the outside world. Because of its popularity and value, it was thought that an English edition would be in demand. The author, translator, and publisher are to be congratulated for their decision in this matter, for this edition satisfies a much needed want by the many ophthalmologists who do not read German with any facility.

The subject matter correlates the clinical (ophthalmoscopic) findings of the diseases of the ocular fundus with the histologic description of the pathologic processes involved. The illustrations are superb and adequate. The text is lucid and exceedingly well translated and edited. Much new material has been added both in text and illustration. It is a volume that every ophthalmologist will want to have in his library and for reference. It will increase in value with time and is truly a collector's item.

Derrick Vail.

The Physiology of the Eye. By Hugh Davson, D.Sc. (London). Philadelphia, The Blakiston Company, 1949. Clothbound, 451 pages, 301 illustrations, index. Price, $7.50.

A fresh and vigorous personal view dominates Davson's compact and systematic presentation of ocular physiology. The volume incorporates most of the significant advances made since the monumental Volume 1 of Duke-Elder's *Textbook of Ophthalmology* was published in 1932. Nowhere else is so much new material so readily accessible but, to my regret, the specific source references have been omitted. Duke-Elder's conception of the aqueous humor is subject to critical reëvaluation; the role of hyaluronic acid in the vitreous, cornea, and lens is detailed; and the latest investigations in all phases—flicker, electrophysiology, photochemistry, color vision—are fairly interpreted.

A practicing ophthalmologist would have inclined toward a more decided clinical bias, and probably would have essayed an analysis of the mechanisms involved in photophobia,

asthenopia, and other ocular symptoms. Davson, as an academic physiologist, has lacked this awareness, but on the other hand has been more fascinated than dismayed by the nebulous implications of theoretical research.

Perhaps it is not surprising to find, even in a book of this quality, some errors. Davson postulates that the trigeminal pupillary reflex is mediated through a connection with the constrictor center, although Adler clearly pointed out that it is purely a vascular reflex. Rochat (Arch. f. Ophth., 118: 260, 1927) found that the dilated pupil that resulted after resection of the sympathetic and oculomotor nerves was insensitive to light or body irritation. Stimulation of the fifth nerve, however, anterior or posterior to the ganglion, produced a pupillary contraction that was affected by adrenalin, but not by atropine.

The chapter on optics is a lucid condensation of the subject and characteristically introduces new material including a review of the X-ray determinations of the length of the eye and the size of the image in the living subject.

Although this volume does not replace the older texts on ocular physiology, it is an invaluable supplement.

James E. Lebensohn.

Doctors of Infamy: The Story of the Nazi Medical Crimes. By Alexander Mitschlerlich and Fred Mielke. New York, Henry Schuman, 1949. 172 pages. Price, $3.00.

By this time the world is somewhat familiar with the Nazi atrocities perpetrated in World War II, proved and documented beyond question. Among these beastly activities, the criminal experiments performed on living human beings by Nazi physicians stand out in unbelievable horror.

The experiments they performed "for the interest of science" and "for the good of the services" involved thousands of helpless people, few of whom survived their superhuman sufferings. The torture and the suffering they endured were all in vain, for nothing of scientific value to mankind was learned by these frightful experiments. Nothing that could not have been found out with more humane methods and the use of experimental animals was added to our knowledge. What a sadistic mockery this is.

The German medical profession shares as a body in the guilt of these experiments, some of which reached their knowledge through scientific journals, others were described at medical meetings by the cruel investigators themselves, without one word of protest, apparently, coming from the audience.

Dr. Mitschlerlich was the head of the German Medical Commission to Military Tribunal No. 1, Nuremberg. The co-author is likewise German. They were as far away from actual participation in the medical crimes of their colleagues as was possible for any German doctor to be. Yet, they feel the collective guilt of their people, and try to atone or at least explain. One of the defendants, Karl Brandt, spoke of "preëminent government interest" to which the physicians must submit.

The authors say "Here again the bonds that tie the physician to society—that is, to human beings who appeal to his aid in their need—are confounded with obedience to absolute state society. . . . Physicians, treating patients under national health insurance, are obliged to communicate their diagnosis to the government officials there employed.

". . . All the gruff commands, all the unconditional obedience, all the chilly ways of bureaucracy—where have they led us but to the very death of brotherly love? And where charity lies entombed, small wonder that millions share its grave, that our very history as a people has become expunged."

This small book contains the protocols of frightfulness and the records of the damned. The reading and rereading of it will make you weep for the victims and the perpetrators. It will make you ask this question, "Is this the end of the road of state medicine?"

Derrick Vail.

ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. Anatomy, embryology, and comparative ophthalmology
2. General pathology, bacteriology, immunology
3. Vegetative physiology, biochemistry, pharmacology, toxicology
4. Physiologic optics, refraction, color vision
5. Diagnosis and therapy
6. Ocular motility
7. Conjunctiva, cornea, sclera
8. Uvea, sympathetic disease, aqueous
9. Glaucoma and ocular tension
10. Crystalline lens
11. Retina and vitreous
12. Optic nerve and chiasm
13. Neuro-ophthalmology
14. Eyeball, orbit, sinuses
15. Eyelids, lacrimal apparatus
16. Tumors
17. Injuries
18. Systemic disease and parasites
19. Congenital deformities, heredity
20. Hygiene, sociology, education, and history

11

RETINA AND VITREOUS

Turtz, C. A. **Solar burns of the fundi.** New York State J. Med. **48**:2489-2490, Nov. 15, 1948.

Three cases of solar burn of the retina due to exposure to sunlight and two cases due to exposure to sun lamps are described. All patients complain of early lacrimation and blurred vision. The pain is caused by the action of light upon the cornea, iris, and ciliary body. Early ophthalmoscopic examination showed gray punctate spots in one case. Four patients had relative central scotomata and one had an absolute central scotoma for green.

The intense heat probably causes a localized vasospasm of the retinal vessels and a compensatory dilatation causes increased capillary permeability. This may lead to severe edema, necrosis of the retina and even to a hole at the macula. The author recommends widespread warning of the dangers from prolonged exposure to sunlight or sun lamps.

H. C. Weinberg.

Urrets Zavalia, A., Jr. **Experimental study on transplantation and replacement of the vitreous.** Ophth. ibero am. **10**:1-20 (Spanish), 21-37 (English), 1948.

For experiments on rabbits, it is recommended to cauterize the part of the sclera where the incision is to be made. After placing a U-shaped scleral stitch, the author incises the sclera with a cataract knife held perpendicularly. He inserts a blunt canula 25 mm. long and 1 mm. in diameter to which he attaches first an empty syringe and then one full of the material to be injected. Although the rabbit eye tolerates replacement of almost the entire vitreous, in man it is not desirable to replace more than 2 cc. The best replacement material is 0.85-percent solution of sodium chloride. The differences between the composition of this fluid and that of the vitreous do not damage the delicate structures with which the fluid comes into contact and the same fact applies to the human eye.

W. H. Crisp.

12

OPTIC NERVE AND CHIASM

Fischer, Frantz. **The appearance of the optic disc in acute retrobulbar neuritis.** Klin. Monatsbl. f. Augenh. **110**:578-580, 1945.

In 56 of 78 cases of acute retrobulbar neuritis an edema of the disc was found, sometimes with a swelling of one or two diopters. They were not different in any other way from the cases with normal discs except that both eyes were usually involved. Gertrude S. Hausmann.

Horton, B. T., and Wagener, H. P. **Retrobulbar neuritis; treatment with histamine.** J. Lab. and Cl. Med. **33**:1611-1612, Dec., 1948.

Histamine, used as a vasodilator to increase the blood supply to the optic nerve in retrobulbar neuritis, is administered as an intravenous drip of 24 to 48 drops per minute for 90 minutes daily or on alternate days for periods of one week to 3½ years. Of 61 patients treated, 24 regained normal vision, and ten regained from 50 to 75 percent of their vision. Typhoid vaccine had been given intravenously to 18 before the histamine therapy. Five of these patients regained normal vision, five were distinctly improved and eight did not change. H. C. Weinberg.

Larsson, Sven. **The macula and its reflexes in optic atrophy due to retrobulbar neuritis.** Acta Psychiat. et Neurol, suppl. 46, pp. 187-193, 1947.

The writer agrees with Haab and Vogt that the observation of the macular reflexes is valuable because changes may be indicative of retinal atrophy in retrobulbar neuritis. This is especially true in unilateral affections where a comparison can be made between the healthy and the diseased eye. No decisive significance can, however, be attributed to them. Disappearance or breaking down of the reflexes must indicate an elimination of the differences of level within the macular area as a result of atrophy, but atrophy can evidently exist even where the structural levels and the reflexes are normal.
Donald T. Hughson.

Marin-Amat, M. **Phantom tumors of the optic nerve.** Ann. d'ocul. **181**:621-626, Oct., 1948.

A 20-year-old woman with exophthalmus of 10 mm. on the left side apparently had a vascular tumor of the optic nerve located near the sclera. A Kroenlein operation was performed; the tumor mass was isolated and removed, and the patient made an uneventful recovery. The tumor which measured 20 mm. by 12 mm. consisted of chronic inflammatory tissue surrounding the nerve. In a similar case, X-ray therapy was successfully employed without operation. Chas. A. Bahn.

Schibdler, H. **Report on a new successful treatment of methyl alcohol poisoning with optic atrophy.** Klin. Monatsbl. f. Augenh. **110**:584-589, 1945.

Four new and three old cases of methyl alcohol poisoning were treated with retrobulbar injections of atropine sulfate. The lasting action of the atropine in retrobulbar application seems to be the most important factor in the treatment. The visual field and the central vision showed marked improvement.
Gertrude S. Hausmann.

13

NEURO-OPHTHALMOLOGY

Ali, Vittorio. **A peculiar reaction of galvanic nystagmus observed during deep insulin coma.** Riv. oto-neuro-oftal. **23**:51-56, Jan.-Feb., 1948.

A woman, 27 years old, showed a peculiar galvanic vestibular reaction during a state of hypoglycemic coma, characterized by monocular abduction toward the positive pole which the writer ascribed to a disturbance of the association between the vestibular and the oculomotor centers. Melchiore Lombardo.

Brain, W. R. **Some observations on visual hallucinations and cerebral meta-**

morphopsia. Acta Psychiat. et Neurol. suppl. 46, pp. 28-40, 1947.

The object of this paper is to report two patients who experienced visual hallucinations and other visuopsychic disturbances, which in one were a symptom of hypertensive encephalopathy and in the other were caused by alcoholism, and to point out that these diverse causes produced hallucinations which not only resembled each other but also possessed features in common with the hallucinations induced by mescaline. The author discusses the location of lesions that cause visual hallucinations and the relation of hallucinations to hemianopia.

Donald T. Hughson.

Mata López, Pedro. **The role of neurovegetative dystonia in asthenopia.** Arch. Soc. oftal. hispano-am. **8**:907-917, Sept., 1948.

The following conclusions emerge from a review of the literature on the disturbances of the autonomic nervous system, and the author's ophthalmologic experience. 1. The existence of a nervous or retinal asthenopia, alone or associated with refractive errors or disturbances of binocular balance, is a clinical entity, caused by a lability or dystonia of the neurovegetative system on a psychosomatic basis. 2. There are two types of asthenopia: the parasympathetic type, caused by a lesion of the frontal portion of the cranial parasympathetic, which is in intimate relation with the oculomotor nuclei, and the sympathetic parasympathetic type, which is a pure psychosomatic dystonia. 3. The exciting factors in the dystonias and the associated asthenopia may be excessive, poorly remunerative work, burdensome responsibilities, improper diet, infections, particularly of the paranasal sinuses, and psychic and hormonal disturbances, especially of the pituitary. 4. There is an endogenous predisposition, influenced by the mode of life and environment of the individual. 5. There is a common type of vegetative asthenopia, rooted in the conflict between the required task, the psychic impetus to carry it out, and the functional capacity for work. 6. The classical pharmacologic tests are no longer regarded important in the diagnosis of neurovegetative disturbances; it is made on clinical symptoms. 7. To avoid confusion in the diagnosis of neurovegetative dystonia, one should seek to establish the etiology, the pathogenesis, the seat and extent of the disturbance, both functional and psychic. 8. In the treatment, rest and diet are important and the drugs which are useful are the depressors of the diencephalic centers, and stabilizing tonics of the vegetative system, such as arsenic, calcium, and phosphorus. Elimination of focal infection, correction of menstrual irregularities, regulation of the diet, prohibition of toxins such as coffee and nocotine, and avoidance of excessive work are parts of the therapeutic pattern. By these means asthenopia which does not respond to correction of refractive errors may be relieved.

Ray K. Daily.

Milletti, M. **The clinical syndrome of the aneurysms of the opticochiasmatic region.** Riv. oto-neuro-oftal. **23**:1-22, Jan.-Feb., 1948.

Cerebral arteriography can determine the nature and the special localization of aneurysms in the anterior cerebral artery, the anterior communicating artery or the endodural internal carotid. Sooner or later, however, they produce identical symptoms according to the size attained or the directions taken in their development and one cannot be differentiated clinically from the other. The writer proposes to group them as a "syndrome of the aneurysms of the opticochiasmatic region." To illustrate he reports in detail

four cases. To differentiate these aneurysms from those of the region of the cavernous sinus he points out that the nerves that control eye movements and the sensory brach of the fifth nerve are affected in the latter. Aneurysms of the region immediately posterior, that of the pes pedunculi, are characterized by isolated paralysis of the third nerve. (9 figures, bibliography.)

Melchiore Lombardo.

Morano, Massimo. **Ocular paralyses in the course of ophthalmic herpes zoster.** Riv. oto-neuro-oftal. 23:37-50, Jan.-Feb., 1948.

Two women, 60 and 70 years old, had recently had herpes zoster of the ophthalmic branch of the trigeminal nerve of one side. Both patients had anesthesia of the affected areas and paralysis of the third cranial nerve and in one patient the fourth nerve was also paralyzed. After the zoster symptoms subside the virus may remain latent for a time and may become virulent again and affect other segments of the ectoderm. To avoid this the writer suggests a treatment with vitamin B_1, methylene blue, X rays and sulfonamides before the virus injures other areas. (1 figure.)

Melchiore Lombardo.

Morone, G. **Pupillographic investigations in myotonic dystrophy.** Boll. d'ocul. 27:481-506, Aug., 1948.

Ten patients were studied by means of pupillography; six of them were suffering from dystrophia myotonica. Two were of the same family as the six others and had some myotonic signs themselves but no dystrophy and the other two were related but were without any pathologic manifestations. In those with frank myotonic dystrophy an atypical pupillotonia was frequently encountered. According to Adie's classification, it may be considered to be an incomplete absolute rigidity. (8 pupillograms; references.)

K. W. Ascher.

Mylius, K. **Meningioma of the ala minor of the sphenoid bone.** Klin. Monatsbl. f. Augenh. 113:105-110, 1948.

The meningiomas of the smaller wing of the sphenoid bone are flat tumors originating from prongs of the arachnoidea. They may penetrate the bone and appear under the skin of the temple. A slowly developing exophthalmos in middle aged persons, facial asymmetry and thickening of the sphenopalatine bone, especially around the optic foramen and the superior orbital fissure are the clinical findings. The author stresses the necessity of special X-ray investigation of this region to avoid the mistaken diagnosis of intraorbital tumor. Involvement of the optic nerve as well as of the nerves passing through the supraorbital fissure may develop in advanced cases. Metastatic carcinoma and aneurysm of the carotid must be excluded. Two patients who had this type of meningioma are described. Max Hirschfelder.

Pau, H. **Supranuclear ophthalmoplegia with bilateral homonym hemianopia due to vascular spasms.** Klin. Monatsbl. f. Augenh. 113:110-113, 1948.

A case of total ophthalmoplegia with homonymous hemianopia and a myocardial infarct is reported. A left-sided hemiplegia and facial paresis accompanied the condition. Symptoms subsided within a month after treatment with strophanthin. Spasms in the region of both medial cerebral arteries were the likely cause of the condition. (References.) Max Hirschfelder.

Piper, H. F. **Ophthalmoplegia after birth trauma.** Klin. Monatsbl. f. Augenh. 113:113-116, 1948.

In a young boy with a supranuclear ophthalmoplegia the voluntary movements were almost lacking in both eyes. Targets could be followed in only a most limited manner. Fixation could not be held when the head was turned slowly but the eyes made rapid reflex movements when the head was turned rapidly. He had convergent strabismus and one eye was amblyopic. A birth trauma was known to have occurred. The author discusses the possible cerebral lesion. He believes that damage to the corticopontine pathways in early childhood was responsible for the lack of spontaneous eye movements. This damage may have been small, but was significant, because it occurred during an important stage of development. (References.)

Max Hirschfelder.

Rubino, A. **Ocular signs and symptoms in the meningocranioses.** Riv. oto-neuro-oftal. **23**:23-36, Jan.-Feb., 1948.

The writer discusses the signs and symptoms which may be found in arachnitis and in endocraniosis (chronic frontobasilar inflammations of Lunadei). Particular attention is given in the discussion to the ophthalmoscopic and perimetric data which frequently reveal a circulatory, neuroretinal, and endocranial disturbance and a lesion of the lower crossed optic fibers at the level of the chiasm (chiasmatic sign of Rubino). (5 figures.) Melchiore Lombardo.

Sjörgren, Torsten. **Hereditary congenital spinocerebellar ataxia combined with congenital cataract and oligophrenia.** Acta Psychiat. et Neurol. suppl. 46, pp. 286-289, 1947.

This rare and peculiar disease has only been described in the literature once before by Marinesco, Draganesco and Vasiliu. The author reports two additional families in which it occurred.

Donald T. Hughson.

Tönnis, W. **The significance of angiographic diagnosis for the treatment of brain tumors.** Klin. Monatsbl. f. Augenh. **113**:97-105, 1948.

Forty percent of brain tumors cannot be exactly diagnosed by means of history, clinical findings and simple X-ray studies. These diagnostically more difficult tumors need further investigation by ventriculography and angiography, two methods which supplement each other. Angiographic X-ray demonstration of aneurysms and angioblastic tumors determines their character, spread and operability. Malignant gliomas often exhibit characteristic vascularization and in 60 percent arteriovenous aneurysms can be discovered by this method. Surgery of meningiomas can be made easier by preoperative study of their blood supply. Dislocation of the blood vessels is helpful for localization, especially in cases of olfactory meningioma. The differential diagnosis between glioblastoma, abscess and subdural hematoma is frequently made easier by angiography. The future of the method lies in the possibility of its use for functional tests of the intracranial circulation. Max Hirschfelder.

Vetter, Joachim. **Eye symptoms in juvenile tabes dorsalis.** Klin. Monatbl. f. Augenh. **110**:581-583, 1945.

It is characteristic for juvenile tabes that the eye symptoms precede the general neurological symptoms, sometimes by several years. The only symptoms an 11-year-old girl showed were loss of vision, optic atrophy and rigid pupils. She was treated with malaria.

Gertrude S. Hausmann.

14

EYEBALL, ORBIT, SINUSES

Espildora-Luque, C., Villaseca, A., Mehech, M., and Ossandon, M. **Two cases of inflammatory pseudotumor of the**

orbit. Arch. Soc. oftal. hispano-am. **8**:879-890, Sept., 1948.

The literature on these bizarre lesions is reviewed and two cases reported. The first case was seen in a girl, 16 years old, who developed left exophthalmos, restricted ocular motility, and ptosis of the left lid. After various therapeutic agents proved ineffective, a diagnosis of a possible malignant tumor was made and a hard mass of tissue was removed from the orbit surgically. A histologic diagnosis of chronic inflammatory process was made. Ten days after the operation a similar mass appeared in the right orbit. Except for a positive Pirquet test the general examination was negative. The etiology of this inflammatory process was therefore assumed to be tuberculosis, but tuberculin therapy was without effect.

The second case occurred in a woman, 38 years old. She had bilateral exophthalmos, associated with severe pain, vertigo and transitory diplopia. The left eyeball had a circumscribed focus of diffuse episcleritis. There were periods of acute inflammatory symptoms and both eyes had retinal detachments which were attributed to the inflammatory process. Treatment was ineffective. Antiluetic therapy with neosalvarsan and bismuth brought some relief from pain but had no effect on the objective manifestations. The patient was lost from observation for two years, when she returned, stating that she was treated during this time with various tonics. The left eye had recovered sufficiently for her to resume work. The exophthalmos receded, motility was restored, there was no sign of episcleritis, and the retina was reattached. There were several foci of pigmented choroiditis, which involved the macula; vision was corrected to 5/15. The right eye remained proptosed, immobile, with high tension, and seclusion of the pupil. It was totally blind and extremely painful. It was enucleated with difficulty, because of the dense cicatricial tissue which bound it within the orbit. The pathologic process involved chiefly the posterior portion of the eyeball; it was characterized by a granulation tissue with a marked tendency to cicatrization which consisted of blood vessels and an abundance of various types of cells, predominantly fibroblasts, lymphocytes, and plasma cells. The infiltration was in part diffuse, and in places had a tendency to form lymphoid nodules. The process extended into the extraocular muscles. The histology gave no clue to the etiology. While the patient was in the hospital she developed an acute exacerbation of the inflammatory process in the right eye, which subsided with antiluetic therapy within 21 days. The authors suggest that antiluetic therapy may be of value in cases of obscure etiology in spite of negative serologic data. (6 figures)

Ray K. Daily.

Goldberg, J. **A Case of spontaneous exophthalmos during delivery.** Brit. J. Ophth. **32**:914-915, Dec., 1948.

A case of sudden, severe, unilateral exophthalmos which occurred during delivery is presented. It slowly and spontaneously subsided, only to recur twelve days after delivery. The diagnosis was orbital hemorrhage. The final result was optic nerve atrophy, and degenerative changes in the macula.

Orwyn H. Ellis.

Klar, R. **Plastic polyviol implants after enucleation.** Klin. Monatsbl. f. Augenh. **113**:145-146, 1948.

The author refers to his former paper on plastic implants and states that he had favorable results when such implants were indicated. He warns against too large an implant, especially for late implants. Iced compresses reduced the postoperative reaction. Max Hirschfelder.

Marin Amat., M., and Gonzales-Novelles, M. B. **Hydatid cyst of the orbit.** Arch. Soc. oftal. hispano-am. **8**:939-945, Sept., 1948.

Poor hygienic conditions, crowded living conditions and poverty led to an increased frequency of hydatid cysts in Spain. The author's case occurred in a five-year-old boy who suffered from recurrent attacks of pain in the left eye associated with edema of the lids. Examination revealed an exophthalmos, limitation of ocular movements, edema of the lids, and descending optic atrophy. A diagnosis of hydatid cyst was made because of a positive reaction to hydatid antigen. The cyst was removed by a Krönlein operation. The symptoms and differential diagnosis are discussed in detail.

Ray K. Daily.

15

EYELIDS, LACRIMAL APPARATUS

Alcalá López, Antonio. **An unexpected finding during a dacryocystorhinostomy.** Arch. Soc. oftal. hispano-am. **8**:1046-1054, Oct., 1948.

In the course of a dacryocystorhinostomy, for chronic dacryocystitis with fistula, the author encountered a dermoid cyst overlying the lacrimal sac. The cyst contained a tooth, and was the source of the fistula. The dacryocystitis is attributed to the compression of the lacrimal sac by the cyst. The pathogenesis of dermoid cysts in this region is discussed, the literature referred to briefly, and the evolution of the lacrimal sulcus is illustrated. (6 figures.) Ray K. Daily.

Allen, J. H. **Diagnosis and treatment of blepharo-conjunctivitis.** J. Iowa M. Soc. **39**:5-8, Jan., 1949.

Blepharo-conjunctivitis may be a generalized inflammation of the lids or a localized lesion. The common forms described may be of either type. Seborrheic blepharitis is usually secondary to seborrheic dermatitis of the scalp. It is usually bilateral with dull dirty gray loose scales on a slightly red lid margin. Yeast cells are found in lid scrapings. Treatment for dandruff and the application of 3-percent ammoniated mercury to the lids three times a day is advised. Staphylococcic blepharitis produces a squamous or ulcerated lesion. The scales are tenacious. Hordeola occur frequently. Treatment with vaccine and toxoid is recommended if local applications of 1/5000 aqueous solution of zephiran chloride with massage and cleansing of the lids are inadequate. Mixed seborrheic and staphylococcic lesions also occur. Morax-Axenfeld blepharitis is characterized by maceration usually at the outer canthi. Treatment with 5-percent sulfathiazole ointment four times a day for four weeks is recommended. Allergic blepharitis may appear as a slight itching or as severe vesiculation and excoriation of the skin. The skin appears thin, wrinkled and often shows eczematoid changes. The treatment is to use the anti-allergic drugs and remove the cause if found.

H. C. Weinberg.

Amyot, Roma. **Hereditary, familial and acquired ptosis late in onset.** Canad. M.A.J. **59**:434-438, Nov., 1948.

Nine cases of bilateral, familial, hereditary ocular ptosis are reported. All appeared after 50 years of age. There was some limitation of upward gaze in three cases. Ptosis is due to a myopathy of the levator. Difficulty in swallowing was present in six patients.

Irwin E. Gaynon.

Arriaga Cantullera, José. **A contribution to dacryocystorhinostomy.** Arch. Soc. oftal. hispano-am. **8**:1031-1036, Oct., 1948.

The modification proposed by Arriaga applies to the closure of the wound, which

is done by a suture similar to the Blascovics suture for strabismus. A number 0 silk suture passes successively through the skin, the periosteum, the anterior flap of the nasal mucous membrane, the anterior wall of the sac, and the skin on the opposite side of the incision. The anterior face of the anastomotic cavity is thus fixed to the skin, and there are no buried sutures. The edges of the skin incision are then co-apted with fine silk. (6 figures.) Ray K. Daily.

Aznarez García, José. **A rapid dacryocystorhinostomy with a continuous suture.** Arch. Soc. oftal. hispano-am. **8**: 1037-1045, Oct., 1948.

The suture described can be understood much better from the illustrations than from a description. It is similar in principle to the Blasckovics suture for myectomy, in which three needles are used on one suture, with the difference that instead of ending in two knots, this one ends in three. The knots are tied over rubber or gauze. The osseous opening is made with a Citelli forceps, rather than a burr. (5 figures.) Ray K. Daily.

Bitran, David. **Accidental ocular vaccination.** Arch. chilenos de oft. **4**:465-470, 1947.

The first patient was a boy of nine years, whose sister had been vaccinated against smallpox two weeks previously. There were three vesicles in the swollen lower lid, and the lymphatic glands of the preauricular and mastoid regions were enlarged. The second patient was a girl of five years whose left lid margins had multiple infection and who had been vaccinated in the right arm a week earlier. The treatment in each case was merely prophylactic, with penicillin, against secondary infection, and no permanent disability resulted. (4 figures.)

W. H. Crisp.

Castresana y Guinea, Angel. **Palpebral edema caused by an intranasal foreign body.** Arch. Soc. oftal. hispano-am. **8**: 1114-1120, Nov., 1948.

A 15-year-old patient had intense palpebral edema of the left eye for about 12 days, which at first was attributed to an insect bite. In the course of a rhinological examination a piece of eraser rubber was found in the left middle nasal meatus. Four years previously the boy accidentally pushed a piece of rubber into his nose, but having no symptoms he had forgotten about it. The pathogenesis of palpebral edema caused by intranasal foreign bodies is discussed, and it is believed that in this case the nasal obstruction interfered with the airation of the paranasal sinuses, which is frequently accompanied by edema of the lids. The possibility of intranasal foreign bodies must be kept in mind in noninflammatory palpebral edema. Ray K. Daily.

Glüh, B. **Suggestions for covering a lid defect according to Kreibig.** Klin. Monatsbl. f. Augenh. **113**:143-145, 1948.

This operation serves to restore a total defect of the upper and lower lid, if the inner canthus is intact and the region surrounding the lids is not destroyed. During a first operation one half of a skin flap is prepared from the skin of the forehead, and its back is covered with mucous membrane from the mouth. The rest of the flap is prepared two weeks later and is put into place in the defect. Restoration of an upper and lower lid necessitates a somewhat broader flap, which finally is split during a third operation a month later. Skin containing hair follicles is taken from behind the ear to restore the eye lashes. (3 figures.)

Max Hirschfelder.

Hartmann, Karl. **Extirpation of a chalazion in a true bleeder with application**

of Vivocoll and chalazion suture. Klin. Monatsbl. f. Augenh. **110**:397-399, May-June, 1944.

The almost fatal bleeding was stopped eventually by injection and surface application of Vivocoll and chalazion sutures. Vivocoll is made from blood of cattle and coagulates rapidly when injected into the bleeding tissue, or is applied to its surface. Two double-armed sutures through the whole thickness of the lid and tied on the skin stop even a severe hemorrhage after chalazion extirpation. George Brown.

MacMillan, J. A. **Diseases of the lacrimal gland and ocular complications.** J.A.M.A. **138**:801-805, Nov. 13, 1948.

The anatomy and histology of the lacrimal gland is reviewed. MacMillan stresses the fact that the aponeurosis of the levator muscles divides the gland into two parts. The cells of the acini are columnar and resemble the serous cells of the salivary gland. The gland is supplied by fibers from the fifth, seventh, and sympathetic nerves. The secretory parasympathetic fibers for the gland are derived from the superior nucleus salivatorius of the seventh nerve in the medulla and through the greater superficial petrosal nerve reach the gland through the zygomatic or lacrimal nerves. The role of the sympathetic nerve in lacrimation is obscure. It conveys vasodilator and vasoconstrictor fibers to the gland, and motor fibers to the basket cells of the acini and tubules. Diminished secretion of tears is found in keratoconjunctivitis sicca (Sjögren's syndrome). Often this is associated with swelling of the parotid gland and arthritis. Neuroparalytic keratitis also occurs with symptoms of drying of the cornea due to postoperative diminution in secretion of tears after surgery or alcohol injection for the relief of fifth-nerve neuralgia. The orbital and palpebral lobes of the lacrimal gland may be removed with safety when Krause's glands are not affected. The protein content of the lacrimal secretion nourishes the anterior layers of the cornea.

Hypersecretion of tears should be treated by removal of the inferior lobe of the lacrimal gland. This should also be done when there is tearing after the lacrimal sac has been excised. Three cases of tumor of the lacrimal gland are described. H. C. Weinberg.

Moreu, Angel. **Recent advances in hemostasis.** Arch. Soc. oftal. hispano-am. **8**:1024-1030, Oct., 1948.

Moreu investigated the effectiveness of jel-foam and thrombin in preventing secondary hemorrhages after dacryocystorhinostomies. Its use in 53 cases convinced him of the value of this hemostatic agent. He uses it as follows: after trephining the osseous opening into the nose, and before incising the nasal mucosa, he places a piece of jel-foam against the mucosa, and holds it there by a piece of gauze saturated in thrombin; while the hemostatics are taking effect on the nasal mucosa the lacrimal sac is opened and prepared for the anastomosis; the nasal mucosa is then incised without hemorrhage; after the anastomosis between the sac and the nasal mucosa is completed, a piece of jel-foam is introduced into the cavity, and compressed against the osseous opening, and another piece placed on the anterior surface of the anastomosed flaps. Ray K. Daily.

Mosquera, Sanchez. **Penicillin and malignant pustule.** Arch. Soc. oftal. hispano-am. **8**:949, Sept. 1948.

Mosquera reports a case of malignant pustule of the lid which was cured within a few days by intramuscular injections of penicillin. The diagnosis was confirmed bacteriologically. Ray K. Daily.

Németh, L. **Surgical treatment of ectropion caused by blepharoadenitis.** Ophthalmologica **116**:162-166, Sept., 1948.

Besides the cicatricial and the paralytic forms of ectropion there is, in the author's opinion, a form due to chronic inflammatory processes at the border as well as in the substance of the lid. This leads to atrophy of the ciliary portion of the orbicularis and to loosening of the lid borders. For its correction the author recommends an operation consisting of: elevation of the skin by means of an intermarginal incision along the entire lid border, carried beyond the proximal edge of the tarsus and extended beyond and upward of the outer canthus where a crescent-shaped piece of skin is excised (similar to the Szymanowski procedure), a canthotomy, and elevation of the tarsus by means of a suture placed in the lower fornix and brought out through the skin of the lower lid. Peter C. Kronfeld.

Pajtáš, J. **Blepharoconjunctivitis due to diocaine.** Ophthalmologica **116**:144-148, Sept., 1948.

The report concerns an elderly woman who first used diocaine topically in 0.2 percent concentration for the relief of intense itching of her eyes. After several weeks of this treatment the itching ceased and the instillations of diocaine were discontinued. Several months later the treatment was resumed and promptly caused acute blepharoconjunctivitis which subsided within five days of abstinence from all drugs. Several months later diagnostic instillation tests revealed marked hypersensitivity to diocaine. The author succeeded in desensitizing the patient by a seven months' course of intramuscular injection of increasing amounts of diocaine. Peter C. Kronfeld.

Tóth, Z. **Functional tests for the lacrimal pathways above the sac.** Klin. Monatsbl. f. Augenh. **113**:158-167, 1948.

Irrigation of the lacrimal sac yields only information about free passage of tears within the sac and lacrimal duct. It does not investigate the more important functions of the punctum lacrimale and the lacrimal canal. The author describes three different procedures to test the function of these parts. In the first a drop of 3-percent collargol is instilled. Collection of brown fluid between lid margin and bulbus indicates stasis. Observation of the punctum when the lid is pulled down slightly enables the observer to study its function and movements. Regurgitation occurs in stenosis of the sac. The play of the punctum is lacking when this part of the lacrimal pathways is involved. A second procedure is the introduction of a small canula into the punctum. A quick passage of the staining media through such a canula is proof that the tear point was the cause of the stasis. The third test consists of transillumination of the lacrimal canal after instillation of collargol into the conjunctival sac. The brown column of fluid can be observed during its passage from the tearpoint to the lacrimal sac. (11 figures, references.) Max Hirschfelder.

16

TUMORS

Bernoulli, R. **Lid carcinoma in a dog.** Ophthalmologica **116**:101-106, Aug., 1948.

A melano-carcinoma in a bitch could be traced back histologically to the Malpighian stratum of a papilloma and to the basal epithelium of an adjacent tarsal gland. Peter C. Kronfeld.

Focosi, M. **An unusual case of trichoepithelioma of the eyebrow.** Boll. d'ocul. **27**:417-423, July, 1948.

A single lobulated tumor, which had developed during two years, was removed from the eyebrow of a 52-year-old man. Histologic examination revealed that the tumor originated from the outer layers of the hair follicles, that there was

no involvement of any sudiferous or sebaceous glands and that small cysts contained an acidophile fluid. Usually these tumors occur in young people, begin as multiple tumors, and are familial. (4 photomicrographs, references.)

K. W. Ascher.

Lowe, R. F. **Intra-ocular phakomata—a report of three cases.** Brit. J. Ophth. **32**:847-853, Nov., 1948.

The author reports three cases of phakoma, two of the Bourneville type (tuberous sclerosis) and one of von Recklinghausen (neurofibromatosis). All three patients were low grade idiots, all had cutaneous and retinal spots and all probably had intracranial lesions. All three had secondary optic atrophy and markedly diminished vision. Morris Kaplan.

MacDonald, A. E. **Lindau's Disease—progression in affected family.** Brit. J. Ophth. **32**:575-580, Sept., 1948.

The familial condition in which multiple capillary hemangioendothelioma occurs in the cerebellum, cerebrum, retina, spinal chord, kidneys, pancreas, epididymis, liver and bone should be termed Lindau's disease. A family is described in which three of four siblings had definite and proved Lindau's disease, and the mother most probably had it. One of the sisters died after three removals for recurrent tumors in the brain and two are apparently well after a single removal of one brain tumor. They have demonstrable tumors in one eye which has been held in check by radium therapy.

Morris Kaplan.

Marin Amat, M., and Marin Enciso, M. **Epibulbar epithelioma cured by diathermy coagulation.** Arch. Soc. oftal. hispano-am. **8**:1142-1144, Nov., 1948.

A 55-year-old woman had an epibulbar carcinoma at the limbus which had been excised twice, and had rapidly recurred each time. The neoplasm was destroyed by diathermy, and the coagulated area was covered with conjunctiva. At the end of four months there was no recurrence. The authors believe that diathermy coagulation should be used rather than the more destructive processes such as X-ray or radium therapy. (1 figure.)

Ray K. Daily.

Scuderi, G.. **The neurinoma of the orbit.** Boll. d'ocul. **27**:507-530, Aug., 1948.

The 61-year-old patient noticed four years ago that his left external canthus itched and was continually sore. Only a few months later, his left eye started to protrude and a tumor developed under his left lower lid. When first seen, he had 8.5 mm. difference on the Hertel exophthalmometer and was otherwise normal. Fundus aand vision were normal. A smooth tumor measuring 3.5 by 2.8 cm., histologically a neurinoma type A (Antoni's classification), was removed from the temporal side of the orbit by external orbitotomy. Some areas showed neurofibromatous changes. The tumor most probably originated from one of the posterior ciliary nerves. The pathogenesis of the neurinomas is discussed. (6 figures, 50 references.) K. W. Ascher.

Stallard, H. B. **Radiotherapy of malignant intraocular neoplasms.** Brit. J. Ophth. **32**:618-639, Sept., 1948.

The tissues of glioma retinae are very radiosensitive and when a quadrant or less of the retina has been affected by the growth, treatment by means of radon seeds has caused the tumor to disappear. In a series of patients treated at St. Bartholomew's Hospital there has been no recurrence in nearly 20 years. The treatment of malignant melanoma is less successful but metastatic carcinoma of the choroid is very radiosensitive and often its treatment is justified. The dose

must be carefully chosen. It must be large, be strong enough to affect the tumor and yet cause minimal damage to the eye. The source of irradiation must be as close to the tumor as possible and in this series the radon needles were sutured to the sclera in apposition to the mass. Tentatively the dose has been set at 3.5 r to destroy glioma occupying one quadrant of the interior of the eye; the seeds are left in place four to eight days.

The technique of application in 15 cases is described in great detail. Complications included irradiation cataract, retinal exudation and hemorrhage, and retinal detachment. Morris Kaplan.

17

INJURIES

Marin Amat, M. **An intraocular BB shot localized and easily extracted under radiographic control.** Arch. Soc. oftal. hispano-am. **8**:1090-1096, Nov., 1948.

A man, 39 years old, was shot in the left eye and a BB shot penetrated the eyeball. Hemorrhage into the vitreous made ophthalmoscopic examination impossible. The shot was localized by X-ray study with the Comberg contact lens. The operative area was coagulated by diathermy, and on the operating table an Arruga localizing pin was introduced into the sclera at the area where the shot was localized. Another roentgenograph taken on the operating table demonstrated that the pin was in contact with the shot. On withdrawal of the pin the shot appeared in the wound and was withdrawn with a Daviel spoon. The patient made an uneventful recovery, with a final visual acuity of 1/10. (4 figures.) Ray K. Daily.

Michaelson, J. C. **Traversing intraocular foreign bodies with retinal detachment.** Tr. Ophth. Soc. U. Kingdom **66**: 193-210, 1946.

The author describes six cases of intraocular foreign body from battle injuries. The foreign bodies frequently traverse the globe, leave the eye posteriorly, and lodge in the orbital tissues because of the high velocity. They may also pass the vitreous tangentially and cause a retinochoroidal lesion in which a massive proliferative choroiditis is the outstanding feature. The mechanism of the detachment in the "tangential" group appears to be traction on the retina caused by contraction of scars in the choroid several months after injury. The trajectory of the foreign body through the vitreous may be marked by a cone of vitreous opacity between the wounds of entrance and exit. Retinal detachment may be remote from the site of reaction in the choroidal wound with its vitreous bands, but no dialysis is found.

If a dialysis is present in an eye with a tangential trajectory, a barrage should be applied to the area of the cicatrizing choroiditis but not too close to the area of proliferative choroiditis, and the subretinal fluid should be evacuated. The treatment of the retinal detachment in the transvitreous injuries is similar to that of retinal detachment in general.

Beulah Cushman.

Senna, S. **Extraction of intraocular foreign bodies under stereoscopic radioscopy.** Arch. Soc. oftal. hispano-am. **8**: 1097-1107, Nov., 1948.

Senna advocates removal of intraocular nonmagnetic foreign bodies under stereoscopic fluoroscopy. The principles involved in stereoscopic fluoroscopy are explained in detail and it is pointed out that the removal of intraocular foreign bodies is a cooperative effort between an ophthalmologist and the author. The ophthalmologist prepares the operative field, and makes the scleral incision in the area determined by accurate localization and coagulated by diathermy; a forceps introduced into the incision is taken over by

the roentgenologist, who removes the foreign body under direct observation. In the method devised by the author the screen is placed vertically at the side of the operating table, and not horizontally above the patient. The dark box for stereoscopic fluoroscopy is adequate for tridimensional perception. The removal of intraocular foreign bodies becomes a simple procedure, aand the results depend on the extent of trauma inflicted by the injury rather than by the surgery. (4 figures.) Ray K. Daily.

18

SYSTEMIC DISEASE AND PARASITES

Borioni, D. **Eye affections observed during breast feeding.** Boll. d'ocul. **27**: 471-473, July, 1948.

Three cases of neuritis of the optic nerves, all unilateral and in regression towards atrophy when first seen, and one of spasm of the accommodation, all attributed to lactation are briefly reported. Other causes were ruled out by careful general physical examination.

K. W. Ascher.

Galindez Iglesias, Fermin. **Some aspects of endocrine exophthalmos.** Arch. Soc. oftal. hispano-am. **8**:1121-1141, Nov., 1948.

The author reviews the literature and reports his investigation of 25 hyperthyroid patients with high metabolic rates. None had fundus lesions. Seven patients had bitemporal contractions of the visual fields of 15 to 30 degrees. The degree of exophthalmos as measured by the Hertel exophthalmometer did not exceed 20 mm. and was below 15 mm. in three cases, in three it was equal in both eyes, and in 22 it was unequal. The author regards normal visual fields indicative of a primary disturbance of the thyroid, and bitemporal retraction suggestive of a thyroid involvement secondary to a pituitary disturbance. Ray K. Daily.

Givner, Isadore. **Some associated eye and skin manifestations of systemic disease.** New York State J. Med. **48**:2700-2705, Dec. 15, 1948.

A brief discussion of diseases which manifest skin and eye lesions is given. The phakomatoses are reviewed. A case of Bourneville's disease is illustrated. A case of Recklinghausen's disease with pulsating exophthalmos is described. Sturge-Weber's disease, in which studies with fluorescein indicate increased capillary permeability, is described. Patients with amino acid deficiencies in which a deficiency of valine was found to cause a corneal dystrophy also showed a loss of total proteins, especially in the albumin fraction. Acute disseminated lupus erythematosus should be considered in patients showing exudates in a fundus with no other vessel changes. It is said to be accompanied by fever and skin lesions which are aggravated by sunlight and sulfonamides. Boeck's sarcoid and its relationship to tuberculosis is discussed. Recurrent aphthous uveitis with mucocutaneous lesions resembles Steven-Johnson's disease and bacteriological studies are reported. Two cases of Vogt-Koyanagi disease, and skin and eye lesions of brucellosis and monocytic leukemia are described. (2 figures.)

H. C. Weinberg.

Lama San Martin, L. C. **Associated ophthalmic and nasal myiasis.** Arch. chilenos de oft. **4**:471-484, 1947.

In this case the offending mosco was Cochliomyia hominivorax. The patient was a man of 66 years who had had his right eye enucleated after an injury 30 years previously. He did not use an orbital prothesis. Four months previously, while working on construction, he had

fallen on a pile of rubble, losing consciousness for a short time. The facial injury was trifling. A developing discomfort in the eye socket received no attention because the man was afraid of losing his job. Three days before the eye examination he had come to the clinic on account of abundant hemorrhage from the mouth, nose, and orbit. He was sent to the eye department because "worms" had been found in the orbital cavity. There was an overwhelmingly fetid odor, and the man had an accelerated pulse rate and elevated temperature. The orbit was completely packed with hundreds of larvae in incessant movement, and similar larvae were promptly encountered in the right nasal cavity. In the course of treatment, and after an X-ray picture had been taken, a little water-pipe cap was extracted from the depth of the right nasal cavity, and a piece of slag from the depth of the orbit. (9 figures.)

W. H. Crisp.

Lindsay-Rea, R. **Ocular disturbances associated with malnutrition.** Tr. Ophth. Soc. U. Kingdom **66**:109-111, 1946.

The author discusses three patients in whom ocular symptoms were associated with malnutrition. A woman, after a reducing program, showed symptoms of Sjögren's syndrome and improved rapidly with 500 mg. vitamin C given intravenously daily for six days, then orally for one month, when the keratitis had disappeared. A man, aged 28 years, had been a prisoner in Siam for four years. His myopia had increased 2 diopters in the right eye and 0.5 diopters in the left. The third patient, a man, aged 25 years, had been in an internement camp in Hong Kong for three years and developed bilateral central blindness with an absolute central scotoma of 5 to 10°. He neither smoked nor drank but his mother had had a disseminated sclerosis with lateral pallor of the disks.

Beulah Cushman.

Lowther, A. H. **Ocular disturbances associated with malnutrition.** Tr. Ophth. Soc. U. Kingdom **66**:104-107, 1946.

The author had charge of 145 patients with malnutritional amblyopia during three and one-half years as a prisoner of the Japanese in Singapore. The onset was usually gradual and the age distribution resembled that of tobacco amblyopia. The visual acuity ranged from 6/60 to 6/5. There was a paracentral scotoma in 64 patients, a pericentral one in 42, and there were small islet defects around the fixation point in some. The blind spot was enlarged in three patients. The clearing of the vision in the center and a gradual change in the ring scotoma suggested that the condition was a retrobulbar neuropathy. Ten patients had bilateral and four unilateral papillomacular atrophy. Forty patients had parasthesia and sensory changes in the limbs and 41 had alterations in the tendon reflexes, 22 had a sore and red tongue and nine had dry eczema of the scrotum. Fourteen cases were severe and showed no improvement at the end of internement, in 41 the vision improved to 6/9 and 90 patients recovered full vision. Although the field defects were not typical of tobacco amblyopia all patients were advised to stop smoking because the author feels that the toxins of tobacco may precipitate the ocular disturbance in malnutrition.

Beulah Cushman.

Mejer, F. **Fundus findings in streptomycin treatment of tuberculous meningitis and miliary tuberculosis of the lung.** Wien. klin. Wchnschr. **60**:842-844, Dec. 31, 1948.

Now that tuberculous meningitis and miliary pulmonary tuberculosis can be successfully treated with streptomycin,

the changes observed in the fundus in these diseases have particular diagnostic significance. In 42 children suffering from these forms of tuberculosis and treated with streptomycin, the fundus was repeatedly examined. Changes in the disc were found in over one-third of the cases. The presence or absence of slight swelling early in the disease has no diagnostic or prognostic significance. Papilledema indicates that the illness will be long and serious. Late changes indicate complications. In over one-third of the cases multiple miliary or solitary tubercles of the choroid were also seen, chiefly in patients with miliary lung tuberculosis. Under treatment with streptomycin these regressed rapidly as the child's general condition improved. Slow regression pointed to complications or other setback. Injury to the optic nerve, sometimes attributed in the literature to streptomycin, is probably due to the disease, not to the drug. However, this needs further study. B. T. Haessler.

Pacheco-Luna, R. **Onchocercosis in Guatemala.** Ann. d'ocul. 181:463-467, Aug., 1948.

This filarial ocular disease was brought to Guatemala by negro slaves from Africa. Now, however, it is not proportionately more frequent in negroes than in other races. In Guatemala, onchocercosis is limited to a zone between 400 and 1600 meters above sea level. The parasite is ovoviperous; the male measures 30 by 0.2 mm. the female, 300 by 0.5 mm. Infected men are inoculated by several species of flies which live near ponds and in very shady places. Only the female attacks man. The micro-filaria are deposited in the skin. They migrate to the stomach and thoracic muscles, and after ten days larvae form. The ocular tissues involved are principally the lid, conjunctiva, cornea and uveal tract. The tissue reaction is variable. The subjective symptoms are most frequently photophobia, blepharospasm, and defective vision. The reaction of the tissues is essentially defensive in that the parasites are walled off from the rest of the body by scar tissue. Living organisms do not usually cause as much irritation as do dead filaria. Parasites have been known to live 20 years, and 20 nodules with enclosed filaria have been removed from the head of one patient. The differential diagnosis includes numerous skin tumors and forms of subacute and chronic keratitis and uveitis. Supplementary diagnostic confirmation may be made by biomicroscopy, biopsy of the skin and conjunctival lesion, and blood count. Eosinophilia is present in 50 percent. The ocular condition is usually progressive and frequently causes blindness by cicatrization. Effective treatment is not known. (16 references.) Chas. A. Bahn.

Pasca, G. **The value of Mester's reaction in ocular manifestations of possibly rheumatic origin.** Boll. d'ocul. 27:439-455, July, 1948.

In 1937, Mester observed a definite relative leukopenia after injecting one cubic centimeter of a 0.1-percent salicylic acid solution under the epidermis of patients suffering from a rheumatic infection. Pasca applied this test to 97 patients of the Sassari Eye Clinic and describes the technique and results in detail. Twelve hours after a meal, five white blood cell counts are taken from an incision in the skin of the finger slightly more than 3 mm. deep. The average of these 5 counts is compared with a similar average obtained 30 to 60 minutes after the intradermal injection of one cubic centimeter of a 0.15 salicylic acid solution, divided into five wheels, each of which contains 0.2 cc. of the solution. Changes up to a 10-percent relative leucopenia were con-

sidered negative; 10 to 15 percent were charted as questionable, and those over 30 percent decrease as strongly positive. Three tables showing age, sex, clinical diagnosis, and additional clinical notes facilitate the comparison of the results of the Mester reactions with those of the Wassermann and tuberculin reactions. Among 50 patients with a possibly rheumatic eye disease 28 had a positive or stronger Mester reaction. Among 10 patients with unquestionably rheumatic disease, the Mester test was positive nine times. Among 27 patients with eye disease other than rheumatic none gave a positive Mester test. In ten subjects suffering from probably tuberculous eye disease the Mester test was always negative. (References.) K. W. Ascher.

Paufique, L., and Guinet, P. **The association of malignant exophthalmus, increased basal metabolism and Parkinsonism with Basedow's disease.** Ann. d'ocul. **181**:665-675, Nov., 1948.

A 60-year-old man developed progressive nonreducible exophthalmos with Parkinsonism and greatly increased metabolic rate. After treatment with aminophylline, gardenal, and diethylstilbestrol the exophthalmus subsided and only a slight hypofunction of the right superior rectus persisted. The left eye was lost from exposure keratitis during a similar attack of exophthalmos. In the development of the symptom complex pituitary dysfunction, and not thyroid, seems dominant. Parkinsonism is discussed in some detail in its relation to numerous encephalopathies.

Charles A. Bahn.

Poos, E. E. **Psychosomatic manifestations in ophthalmology.** J. Aviation Med. **19**:442-446, Dec., 1948.

Psychosomatic manifestations are in the main produced by stimulation of the sympathetic or parasympathetic systems. Conversion hysteria may manifest itself as hysterical amblyopia, amaurosis, blepharospasm, angioneurotic edema and photophobia. Convergence paresis and headaches following accidents are examples of neurasthenia. An anxiety state may cause a ciliary spasm.

Irwin E. Gaynon.

Satyasray, R. S., **Night-blindness.** Calcutta M. J. **45**:272, July-Aug.-Sept., 1948.

The author is aware of the importance of vitamin A in night-blindness and discusses particularly and in detail the vitamin content of foods used in India.

F. H. Haessler.

Schepens, C. L. **Is tobacco amblyopia a deficiency disease?** Tr. Ophth. Soc. U. Kingdom **66**:309-331, 1946.

The author reports on the incidence of tobacco amblyopia in Belgium before the war, when it was seldom found, and then on fifty times as many cases in 1942. He questioned whether it was due to the consumption of tobacco of poor quality, associated with the intake of adulterated alcohol or a deficiency of food. The patients who used the war-time homegrown tobacco suffered most severely. Alcohol consumption seemed to have little influence on the tobacco amblyopia. The moderate smoker who developed tobacco amblyopia was generally undernourished. The disease had occurred between the ages of 55 and 65 years but now was seen in subjects near the age of 30 years. It was frequently associated with emotional shock. Fundus alterations were found more frequently in the undernourished patients as were the general symptoms of tobacco intoxication. The form and position of the centrocaecal defect bears a relation to the cilioretinal angioscotomas. It expanded in all directions around the blind spot and tended

to be pericaecal instead of centrocaecal. The author believes that tobacco amblyopia occurs when the intake of toxic substances resulting from tobacco consumption exceeds the capacity of the liver to neutralize these poisons. The clinical picture was altered during the war because of the chronic undernourishment. The poison seems to act on the retina itself and not on the optic nerve. (12 figures.)

Beulah Cushman.

Simpson, Thomas. **Papilloedema in emphysema.** Brit. M. J. pp. 639-641, Oct. 2, 1948.

Three patients are described who had emphysema with bilateral papilloedema and engorgement of the retinal veins. The literature is briefly reviewed and the possible theories as to the causes of the papilloedema are discussed. A rise in general venous pressure does not provide a sufficient explanation and an intracranial factor is postulated. The author believes, from observations on animals and on his patients, that because of a lack of oxygen and an accumulation of CO_2 in the arterial blood of emphysematous patients, there is enough cerebral vasodilatation to raise the cerebrospinal fluid pressure to the level at which papilloedema ensues. The possibility that polycythaemia, which often appears in emphysema, could be a cause of the papilloedema is discarded by the author. His patients did not have a high red blood cell count. (2 tables.)

H. C. Weinberg.

Skinsnes, O. K. **Generalized ochronosis; report of an instance in which it was diagnosed as melanosarcoma with resultant enucleation of an eye.** Arch. Path. **45**:552-558, April, 1948.

The remaining eye of a man was removed for pain and a blue-gray discoloration of the sclera. The preoperative ocular diagnosis was melanosarcoma but no neoplastic growth was found on a gross examination. The man died from what was interpreted as bronchopneumonia. Autopsy showed, among other findings, a marked dorsal kyphosis, arthritic fusion of the vertebrae, a marked raven-black pigmentation of all cartilages examined, less intense pigmentation of the endocardium and aortic endothelium, and a bluish discoloration of the ears and the fingernail beds. The first eye had previously been removed after trauma.

The eye had been removed because ocular ochronotic pigmentation had been mistaken for melanosarcoma. The triad of pigmentation of the ears and sclera, dark color of the urine, and arthritis is pathognomonic of ochronosis.

Francis M. Crage.

19

CONGENITAL DEFORMITIES, HEREDITY

Stadlin, W. and Klein, D. **Congenital ectopia lentis with spherophakia and brachymorphia accompanied by gaze paresis.** Ann. d'ocul. **181**:692-701, Nov., 1948.

The above symptoms are called the syndrome of Marchesani. Four familial cases are presented to illustrate a genetic tree in which the parents were cousins, though not affected. In the patient most affected slight ptosis was accompanied by a defect of ocular elevation, small round lenses displaced upward, and limited movements to the left. The patient also had short small hands and feet and mental retardation. This syndrome is considered to be a dominant hypoplasia of mesodermal tissues. In the Marfan syndrome, in contrast, the principal symtoms are dolicocephaly, long fingers and toes, and ectopia lentis. Chas. A. Bahn.

Vrabec, F. **The pathogenesis of freely movable intraocular cysts.** Ophthalmologica **116**:129-140, Sept., 1948.

The author found a small intraocular cyst in one eye of a 10-week-old human embryo. By means of a narrow stalk this cyst was connected with the marginal sinus of von Szily. In the wall of the cyst the very beginning of the differentiation of retinal pigment cells could be observed. Cystic formations which arise from the marginal sinus may, in the mature eye, be located in the anterior chamber or in the viterous cavity. The author favors the theory of origin of all congenital, free, intraocular cysts from the marginal sinus. (See Perera, Archives of Ophthalmology **18**:1015, 1936.)

Peter C. Kronfeld.

20

HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Chavarría López, F. A. **Comment on ocular hygiene.** Arch. Soc. oftal. hispanoam. **8**:985-987, Oct., 1948.

Chavarría points out the danger of ocular contagion from the trying on of sunglasses in optical shops. He suggests that the ophthalmological society work for legislation requiring that sun glasses be kept in tightly closed cases, kept sterile by formalin tablets. Ray K. Daily.

Hartmann, E. **Psychosomatic phenomena in ophthalmology.** Ann. d'ocul. **181**: 588-603, Oct., 1948.

Every ophthalmic function may be involved in psychosomatic disease. Among angiospastic disfunctions are migraine and numerous retinopathies with or without exudation and hemorrhages. Motor disturbances include blepharospasm, mydriasis, myosis and refractive changes. Sensory changes include photophobia as well as dysthesias; the chief secretory disturbance is lacrimation. The course of numerous structural diseases such as diabetes mellitus, hyperthyroidism, glaucoma and the phorias and tropias is modified by psychosomatic factors. A series of brief case histories illustrates the psychosomatic factor in several of the conditions mentioned as well as the results of understanding psychosomatic treatment. Chas. A. Bahn.

Livingston, P. C. **Visual protection in aerial warfare.** Brit. J. Ophth. **32**:689-700, Sept., 1948.

The destruction of sight seemed to be so little feared by aviators that difficulty was experienced in persuading personnel to take reasonable precautions against ocular injury. Some methods of assuring eye protection were the use of bullet proof glass screens and armour plates fitted within the structure of the aircraft, of flight goggles fitted with safety glass, either plain or ground to prescription, or of contact lenses where refractive errors cannot be otherwise adequately treated. Visual training in the best use of the eyes in low illumination is also of considerable help. The record of eye injuries among the R.A.F. in flying operations justified the campaign against the hazard of loss of sight.

Morris Kaplan.

Melanowski, W. H. **The more important pages from the history of Polish ophthalmology.** Tr. Ophth. Soc. U. Kingdom **66**:265-290, 1946.

The author outlines Polish ophthalmology from the year 1220 to the present time and describes the original work of many individuals in ophthalmology. In 1903, Galezowski, for example, presented before the French Ophthalmological Society results of his cautery of the tear in retinal detachment similar to those which Gonin described in 1929.

Twenty-seven ophthalmologists, other medical personnel, and university professors were murdered by the intruders

in the last war. Many of their hospitals have been burned down or robbed during the war, but postwar research is going on.

Beulah Cushman.

Redslob, E. **The causes of blindness of twenty years ago and today.** Ann. d'ocul. **181**:535-543, Sept., 1948.

Surveys made in 1928 and 1948 in an institute for the blind, showed a decrease in gonorrheal ophthalmia and phlyctenular disease. Congenital affections, however, had increased. Pigmentary retinal degenerations rose from 3.8 percent in 1928 to 15 percent in 1948. Congenital glaucoma also increased. Several cases of amblyopia are briefly described; no objective symptoms were observed which accounted for visual impairment. Traumatic cases numbered approximately the same in both surveys. Chas. A. Bahn.

Rychener, R. O., and Robinson, A. **Reading disabilities and the ophthalmologist.** Tr. Am. Acad. Ophth. pp. 107-120, Nov.-Dec., 1948.

Primary reading disability is one of a seven syndrome complex of language developmental disorders as classified by Orton. Etiologically, reading has been shown to be a complex activity requiring the functional integrity and interplay of several brain areas, including the angular gyrus of the dominant hemisphere. Birth injuries and disorders of myelination of cerebral tracts are among the suggested etiologic factors. The problem, although mainly educational, is of interest to the ophthalmologist because it is he who most often sees the patient first, and who must recognize the condition and refer the patient to a reading clinic where proper treatment can be instituted. Diagnosis is based upon a careful history and a brief test in reading and spelling certain words which a poor reader most often tends to jumble. Transposing such letters as B and D, P and Q, and reversing words, "was" for "saw," and "no" for "on," are common examples. The reading lists are prepared for various age and educational levels. Quantitative determinations of the severity of reading disability are made with the ophthalmograph. Evaluation of reading ability is made through determinations of words read per minute, fixations per hundred words, span of recognition, and comprehension. Two hundred and twenty-five patients with reading disability were investigated. Of these, 35 percent were definitely in need of remedial reading classes, 45 percent needed less rigorous treatment, and 10 percent were not amenable to treatment. In the latter group, the disability was attributable to convergence insufficiency. Correction of reading disability can be brought about through the the use of phonetic and kinesthetic training methods. Morale must be kept at a high level, and the patient's confidence in himself established. A bibliography on reading disability is presented to the patient in order that he may gain some insight into his problem. The patient receives a form letter which outlines the course of treatment. Chas. A. Bahn.

Somerville-Large, L. B. **The first Irish ocular pathologist. Arthur Jacob—(1790-1874).** Brit. J. Ophth. **32**:601-617, Sept., 1948.

The life and ophthalmologic contributions of Arthur Jacob, great Irish oculist of the nineteenth century are presented in some detail. He founded two ophthalmic hospitals, a medical school, a medical journal and served as professor of anatomy and physiology for 41 years. He was the first to describe the nerve layer of the retina (membrana Jacobi) and the rodent ulcer of the lids (Jacob's ulcer). He read his "Account of a membrane in the eye"

before the Royal Society in 1819 in which he described a membrane attached to the retina and also attached to the choroid; apparently he was describing the neural layer only and he was quite widely acclaimed for his observations. In 1827 he published in the Dublin Hospital Reports "Observations respecting an ulcer of peculiar character which attacks the eyelids and other parts of the face." Here he described with much accuracy the condition now known as rodent ulcer and very little has been added to his description. Morris Kaplan.

Williamson-Noble, F. A. **Adaptation to environment.** Brit. J. Ophth. **32**:673-677, Sept., 1948.

The author considers the fitness of men for the task of ophthalmology and also the effect of ophthalmology on the men who practice it. Most men seem to go into medicine in rather a haphazard fashion and it is rather extraordinary that most doctors make good. Are we all worn into the same shape after 15 to 20 years of ophthalmic practice? The author examines the characteristics one may justifiably look for in an ophthalmologist of some years experience.

He became aware that his patients behaved much better than they did 20 years ago. First he ascribed it to improved preoperative techniques but soon realized that it was he who had changed. His confidence in himself had increased and it was easier to impart this confidence to his patients. Morris Kaplan.

Wright, W. D. **Colour vision, 1868 and 1948.** Brit. J. Ophth. **32**:597-601, Sept., 1948.

A history of the acquisition and organization of our knowledge of color vision in which Sir John Parsons has played so great a part, is presented. In 1924 Sir John published his remarkable book on color vision. Of utmost importance has been the realization that study of color must consider the physical stimulus, the physiological reaction, and the psychological sensation. Morris Kaplan.

Historical Miniature

Hirschberg (*Graefe-Saemisch Handbuch*, volume 13, pp. 330) points out the striking similarity between the outstanding British ophthalmographer who edited a second edition of a translation of Jacques Guillemeau's *Des Maladies de l'Oeil qui sont en Nombre de Cent Treize aux quelles il est Subject* in 1622 and his German counterpart, George Bartisch, who published his *Augendienst* in 1583. To Bartisch may be assigned almost the same place in German ophthalmology that is given to Hans Sachs in poetry.

Both Banister and Bartisch were characterized, on the one hand, by the narrow mindedness of the guild member, the jealousy of the competing tradesman, and superstition and, on the other, by sincerity, the proficiency of the skillful craftsman, a lively literary style, and a considerable poetic gift.

NEWS ITEMS

Edited by Donald J. Lyle, M.D.
601 Union Trust Building, Cincinnati 2
News items should reach the editor by the 12th of the month

Announcements

Wills clinical conference

The first annual clinical conference of the Wills Hospital will be held in Philadelphia, May 6 and 7, 1949. Members of the hospital staff and ex-resident physicians will provide the program which will consist of lectures throughout both days and an evening session on May 6. Eye operations will also be scheduled for both days.

Among the papers to be presented are: "Some practical facts regarding retinal surgery: With a report of results in more than 400 unselected and consecutive cases," Dr. James S. Shipman; "The surgical corrections of ptosis, congenital and acquired, when complicated by other oculomotor situations," Dr. Edmund B. Spaeth; "Causes of failure in the surgical treatment of glaucoma," Dr. John S. McGavic; "A followup concerning basket implants," Dr. Wilfred E. Fry; "Study of end results of glaucoma at the Wills Hospital, 1936 to 1948," Dr. Louis Lehrfeld; "Dibutyline sulfite: A comparative study of its cycloplegic effects," Dr. Bernard C. Gettes; "Further studies of the chemical and immunilogical properties of human tears," Dr. Irving H. Leopold; "Ophthalmoplegia due to secondary malignancy at the orbital apex," Dr. Issac S. Tassman; "Diagnosis of syphilitic primary optic atrophy in the pre-atrophic stage," Dr. Joseph V. Klauder and Dr. George P. Meyer; "The optics of cylinder magnification," Dr. Joseph W. Hallett.

Guest speakers for the occasion will be Dr. Cecil O'Brien of The State University of Iowa, and Dr. Arthur J. Bedell of Albany, New York. At the conclusion of the conference the Wills Hospital Society of ex-Resident Physicians will hold its annual meeting.

Orthoptic instruction course

The American Orthoptic Council announces the second annual course of instruction for orthoptic technicians. This course consists of two parts; the first, 9 weeks of lectures, demonstrations, and laboratory work by outstanding ophthalmologists and certified technicians, from June 25 to August 27, 1949, at Nasson College, Maine.

This basic instruction will be followed by the second part which consists of 6 to 12 months of practical work in clinics and offices, throughout the United States, under the supervision of certified orthoptic technicians. Completion of the full course will qualify the student to take the American Orthoptic Council examinations. For further information, write the American Orthoptic Council, 1605 22nd Street, N.W., Washington 8, D.C.

Strabismus symposium

A symposium on strabismus is to be held at the University of Iowa May 22 through 28, 1949. In addition to the regular staff of the department of ophthalmology the following guest lecturers will participate: Dr. Walter B. Lancaster, Boston; Dr. Francis H. Adler, Philadelphia; Dr. Harold W. Brown, New York City; Dr. Frank D. Costenbader, Washington, D.C.; Dr. Kenneth C. Swan, Portland, Oregon; Dr. George P. Guibor, Chicago; Dr. Richard G. Scobee, St. Louis; Dr. Walter H. Fink, Minneapolis, and Dr. Hermann W. Burian, Boston.

Further information regarding the details of the course may be obtained from Dr. James H. Allen of the department of ophthalmology, University of Iowa Medical School, Iowa City, Iowa. The registration fee is $150, and the enrollment will be limited to 25 physicians.

Wayne graduate degree

Through the facilities of the College of Medicine, the Wayne University Graduate School, Detroit, is now offering graduate work leading to the degree of master of science in ophthalmology.

Oxford Ophthalmological Congress

The Oxford Ophthalmological Congress will be held on July 7, 8, and 9, 1949, at Oxford, England. The Doyne Memorial Lecture will be given on this occasion by Professor Goldman of Berne, Switzerland. The main topic of discussion before the congress will be "Principles and practice in maintaining asepsis during ophthalmic operations."

Orthoptic examinations

Applications for the examinations to be conducted by the American Orthoptic Council during September and October, 1949, will not be accepted after July 1, 1949. Until that date applications will be received by the office of the secretary, Dr. Frank D. Costenbader, 1605 22nd Street, N.W., Washington 8, D.C., and must be accompanied by the examination fee of $25.

Miscellaneous

Clinic for corneal disorders

A new eye clinic for diagnosis and treatment of corneal disorders has been established at the Manhattan Eye, Ear, and Throat Hospital, 210 East 64th Street, New York, as a coöperative undertaking sponsored by The Eye-Bank for Sight Restoration, Inc., and the hospital.

Under the direction of Dr. R. Townley Paton, the clinic meets at 9:30 A.M. every Wednesday morning when the patients are assembled and examined by Dr. Paton and his staff, including Dr. Herbert M. Katzin, director of the Eye-Bank Laboratory. They are assisted by a nurse, a nurse technician, a secretary, and a social worker.

The patients are referred to this clinic from the other eye services of the Manhattan Eye, Ear, and Throat Hospital, from other physicians, from public health organizations, and from some of the national and state societies for the prevention of blindness.

Complete records, including photographs and progress notes, are maintained. Visiting physicians are welcomed to observe the work of the clinic and to see the cases both before and after operation.

N.S.P.B. PROGRAM

At the 40th anniversary conference of the National Society for the Prevention of Blindness, the following program was presented.

"The battle against blindness," Mr. Mason H. Bigelow, president of the society; and "The next 40 years," Dr. Franklin M. Foote, executive director.

Dr. Conrad Berens, New York, chairman of the panel on "Conserving vision for old age," presented the following speakers: Dr. Edwin B. Dunphy, Boston, "How does middle age affect the eyes?"; Mr. Theodate H. Soule, New York, "Family and social problems of eye patients"; Dr. Henry L. Birge, Hartford, Connecticut, "Psychosomatic eye problems"; Dr. A. L. Chapman, United States Public Health Service, Washington, "What can the public health worker do?" Dr. Brittain F. Payne, New York, was discussant.

The panel, "Better sight for youth," had as its chairman, Dr. Leona Baumgartner, New York, and the speakers were: Dr. George N. Shuster, New York, "Vision in education"; Dr. Albert E. Sloane, Boston, "Sight as it affects the power to learn"; Mr. C. L. Crouch, New York, "Lighting the classroom."

The chairman of the panel on "Teaching the child with defective eyesight," Dr. Frank J. O'Brien, New York, introduced: Dr. Hunter H. Romaine, New York, "Reading and eye trouble"; Dr. Romaine P. Mackie, Washington, D.C., "The partially seeing child in urban and rural areas." Dr. Vivian Ellis, Albany, New York, was the discussant.

The panel, "Vision in industry," had as chairman, Mr. W. J. Niederauer, New York, who presented the following speakers: Mr. R. L. Otten, Baltimore, "What an eye program can do for management"; Dr. Ralph S. McLaughlin, Charleston, West Virginia, "The ophthalmologist's contribution to industry"; Mr. L. M. Endres, Washington, "Using light and color"; Mr. A. G. Bungenstock, Kearny, New Jersey, "Promoting eye safety"; Cmdr. R. Roswell Sullivan, "The Navy eye program."

Dr. Eugene M. Blake, New Haven, Connecticut, was chairman of the panel on "Medical progress in eye health." Speakers on this panel were: Dr. V. Everett Kinsey, Boston, "Retrolental fibroplasia"; Dr. Joseph Warkany, Cincinnati, "Congenital abnormalities of the eye: Some etiologic considerations"; Dr. Frank D. Costenbader, Washington, "Treatment of crossed eyes"; Dr. Alan C. Woods, Baltimore, "Pigment degeneration of the retina"; Dr. Dorland J. Davis, Bethesda, Maryland, "Epidemic sore eyes in the Rio Grande Valley."

Dr. Willis S. Knighton, New York, was moderator for the panel discussion on "Glaucoma: An increasing public health problem." Dr. Solomon S. Brav, Philadelphia; Miss Margaret Gnade, Pittsburgh; and Miss Helen E. Weaver, New York, discussed "What needs to be done about glaucoma?" Mr. Erik Barnouw, New York; Mr. Willard Van Dyke, New York; and Miss Jane Stafford, Washington; discussed "How can the average citizen be warned about the danger of glaucoma?"

Miss Helen Keller was guest of honor at the conference dinner at which Dr. Marcus D. Kogel, New York, spoke on "The place of the hospital in preventive medicine," and Dr. John Z. Bowers, Washington, spoke on "Atomic energy and eyesight."

ORTHOPTIC CLINIC DEDICATED

On February 4 the Barbara Gregg Ingalls Orthoptic Clinic was dedicated at the Medical College of Alabama in the Thigpen Eye Hospital. It was named in honor of the granddaughter of Mr. Robert I. Ingalls, Sr., industrialist-philanthropist, who has indicated a continuing interest in the clinic. Orthoptic examination and treatment are now offered without charge to the indigent children of Alabama.

WILLS HOSPITAL APPOINTMENTS

Dr. Carroll R. Mullen has been named executive surgeon to the Wills Hospital. This position has not been filled since the death of the late Dr. J. Milton Griscom. Dr. P. Robb McDonald has been appointed attending surgeon to the Wills Hospital succeeding Dr. Frank Parker, who has retired after 40 years of continuous service to this institution. Dr. Warren S. Reese has been elected president of the board of attending surgeons, Dr. James S. Shipman is vice-president, and Dr. Wilfred E. Fry is secretary.

SOCIETIES

MILWAUKEE CLINICAL PRESENTATION

The February 15 meeting of the Milwaukee Oto-Ophthalmic Society was held at the United States Veterans Hospital. Those making clinical presentations of ophthalmic cases were: Dr. George Roncke, Dr. Arvid Holm, Dr. Thomas Burns, Dr. Erwin Grossmann, and Dr. John Hitz.

CENTRAL ILLINOIS MEETING

The next meeting of the Central Illinois Society of Ophthalmology and Otolaryngology will be held at the Pere Marquette Hotel, Peoria, Illinois, on April 22, 23, and 24, 1949.

Dr. Donald J. Lyle, professor of ophthalmology, University of Cincinnati, will give lectures on: "Clinical diagnosis of lesions of the visual system," "Eye involvement resulting from head in-

juries," "Clinical study of vascular affections of brain and eye."

Dr. B. E. Ellis, associate professor of otolaryngology, Indiana University, will lecture on "Congenital cysts of the head and nasal bridge," "Congenital cysts of the neck," "Rhinoplasty procedures in the practice of otolaryngology."

Mrs. Ben Humphrey Gray, executive secretary of the Illinois Society for the Prevention of Blindness, will speak on the school visual screening program in Illinois.

Reading meeting

The 90th meeting of the Reading Eye, Ear, Nose, and Throat Society, held February 16th, was the fifth annual joint meeting of the Diplomates Association of Berks County Physicians and the Reading Eye, Ear, Nose, and Throat Society. The speaker was Dr. Stephen S. Hudack of New York who discussed "Restoration of joints with articular replacement and changing concepts in the mechanism of bone healing."

Wilmer Residents Association

On the program of the eighth clinical meeting of the Wilmer Residents Association, April 6 to 8, at the Wilmer Institute, Baltimore, are:

"Classification and special symptomatology of uveitis," Dr. Alan C. Woods; "Surgical correction of horizontal strabismus: A new concept of the mechanics involved," Dr. Jack S. Guyton; "Some ocular effects of a new anticholinesterase agent, tetraethyl pyrophosphate (T.E.P.P.)," Dr. William G. Marr; "Modern status of antibiotics," Dr. Perrin Long; "A new variety of corneal pigmentation," Dr. Robert C. Laughlin; "Vitamin E studies in relation to retrolental fibroplasia," Dr. William C. Owens and Dr. Ella Uhler Owens; "Polysaccharides in ocular tissue," Dr. Robert Day; "Histochemical localization of choline esterase in ocular tissue," Dr. George B. Koelle.

"Heparin and ocular hypersensitivity," Dr. Malcolm W. Bick and Dr. Ronald Wood; "The etiological diagnosis of uveitis," Dr. Alan C. Woods; "Sympathetic ophthalmia following intraocular surgery," Dr. Howard A. Naquin; "New radon and radium-D applicators," Dr. William F. Hughes, Jr.; "Corneoscleral trephine and intracapsular extraction in one procedure for primary glaucoma combined with cataract," Dr. Angus L. MacLean; "Inhibition of mitosis in the corneal epithelium by ionizing radiation," Dr. Jonas S. Friedenwald; "Cataract section following filtering operations," Dr. Russell T. Snip; "A battery-handle extension for the Bausch and Lomb ophthalmoscope," Dr. Norman R. Davis; "Surgical management of the iris," Dr. John M. McLean; "The anatomy of neurologic defects in pituitary tumor," Dr. Frank B. Walsh.

"Selection of operation in acute glaucoma," Dr. Herman K. Goldberg; "Treatment of uveitis," Dr. Alan C. Woods; "Surgery of the horizontal recti: Approach through a concealed conjunctival incision," Dr. Jack S. Guyton; "Total color blindness," Dr. Louise L. Sloan and Miss Lorraine Wollach; "Demonstration of new retinal recording methods from the intact eye," Dr. Carlton C. Hunt, Dr. Stephen W. Kuffler, and Dr. Samuel Talbot; "Prognosis for vision in anoxia," Dr. Walter H. Benedict; "Use of radioactive indicators for study of aqueous humor," Dr. Roy O. Scholz; "Changes in intraocular pressure following miotics," Dr. Rufus C. Goodwin; "The effect of retrobulbar alcohol injections on the eyes of experimental animals," Dr. Walter Kornblueth; and "Clinical pathological conference," Dr. Jonas S. Friedenwald and Dr. Howard A. Naquin.

Personals

Tulane University lecturer

Dr. F. L. P. Koch discussed "The eye in internal medicine," at the postgraduate course in general medicine conducted recently at the School of Medicine of The Tulane University of Louisiana.

Receives Dana Medal

The Leslie Dana Gold Medal for 1948, a national award given annually for outstanding achievement in the prevention of blindness and the conservation of vision, was presented on March 25th at a dinner in St. Louis to Dr. Lawrence T. Post of that city.

Dr. Post was selected for this honor by the St. Louis Society for the Blind, through which the medal is offered by Mr. Leslie Dana of St. Louis. This important award in the field of public health is given upon the recommendation of the Association for Research in Ophthalmology.

Erratum

The hormone referred to in the discussion by Dr. P. Robb McDonald on page 281 of the February, 1949, issue of the Journal should have been the melanophore expanding hormone of the pituitary gland instead of Marfan's hormone, as reported.

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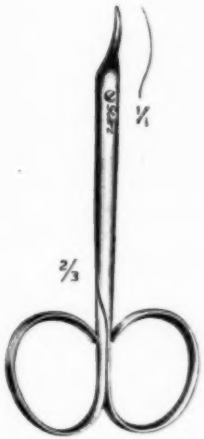

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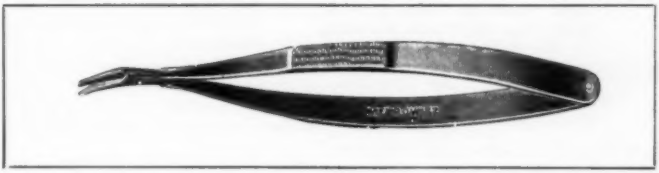

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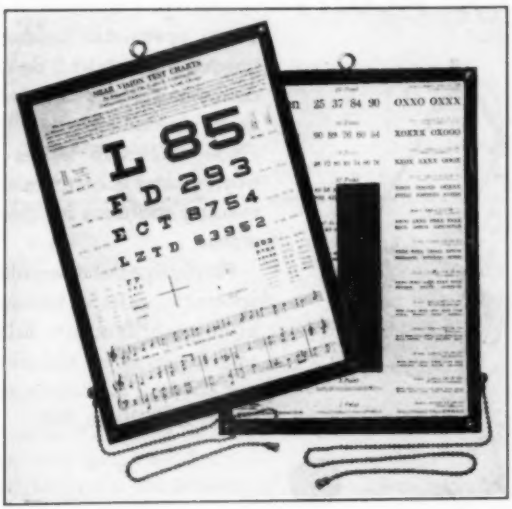

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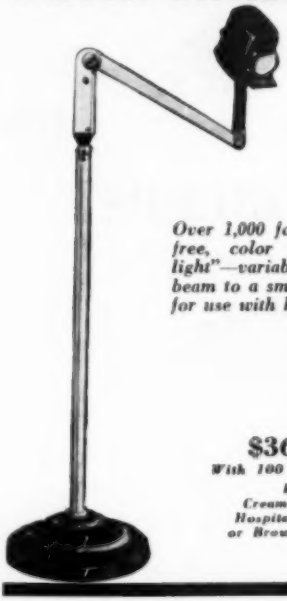

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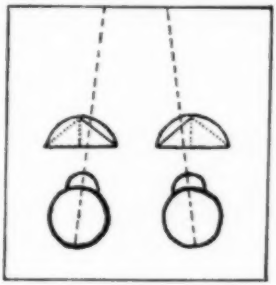

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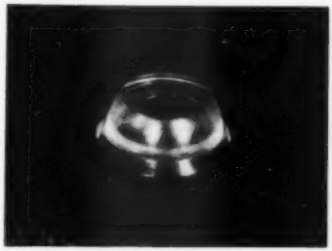

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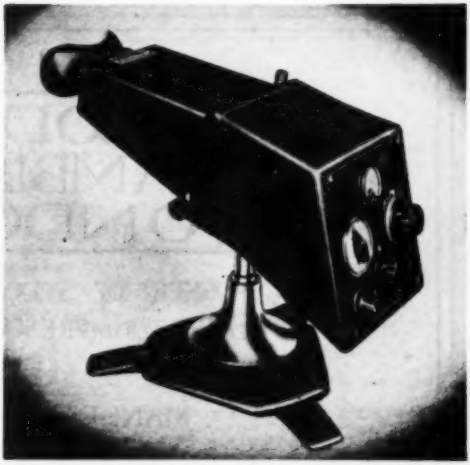

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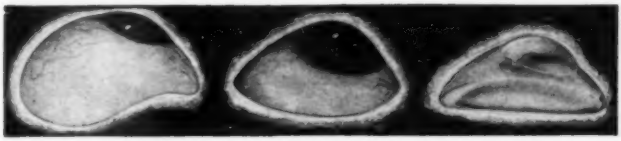

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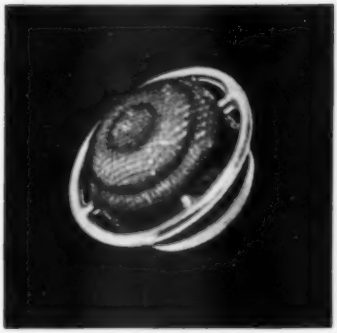

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